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ENGINEERING NEWS.

THE NICARAGUA CANAL COMPANY, according to a report issued by the Canal Commissioners of the Nicaragua Government, has accomplished the following work since the landing of the construction party on June 8 last:—The town of America has been founded; a 12-mile aqueduct commenced; a mile or more of broad-gauge railway laid; 35 miles of telegraph line put up; the San Juan, Guanillo, Deseado, and Silico Rivers cleared of obstructing snags; twenty or more permanent camps built; piles and pile-drivers for the break-water are landed; and the first part of the canal route is cleared. Besides this work, the company has organized a perfect supply and transportation system; a hospital and ambulance service, and so perfected the sanitary arrangements that there is only a small percentage of sickness. Dredges are being built in the United States and in Renfrew, Scotland, and are promised to be ready for work early next spring.

A NEW OCEAN CABLE COMPANY is about to connect Charleston with Hayti, San Domingo, Cuba, and other West Indian islands, the line extending to Martinique and thence to Venezuela. The work is to be done by a French company, and the line is likely to benefit American commercial relations with the West Indies.

THE NEW ORLEANS BRIDGE over the Mississippi River is to be at once examined and reported upon, as to site, by a commission of United States Engineers already appointed. The bridge bill is before Congress, and as the Secretary of War has declared his opposition to the construction of a bridge over any navigable stream that will in the slightest degree interfere with the use of that stream by the people, it is expected that nothing but a first-class bridge in design and location will be approved of for this point, if recommended at all.

A BRIDGE ACROSS THE MISSOURI RIVER at Sioux City, Ia., is being talked of. A company is reported to have been formed in the interest of the syndicate, which is building the Pacific Short Line R. R. from Sioux City to Ogden, Utah, to build a combination railway and wagon bridge across the Missouri River at Sioux City, Ia. The bridge will be 2,280 ft. long, carrying steam and cable car tracks, and an extra floor for pedestrians and wagons. It is estimated to cost $1,000,000.

THE WINNER BRIDGE, over the Missouri at Kansas City, is well under way and it is to be completed within the next ten months at a cost of $1,200,000. One of the nine pier foundations, Pier No. 7, is the most advanced, and No. 6 caisson is being built. The pneumatic process is being used for sinking these piers. The bridge over the river proper will have two spans of 276 ft. each and four spans of 428 ft. each, or 2,274 ft. in all. The span over the Hamilton tracks will be 150 ft. and the trestle work between this and the river bridge will be 1,900 ft. long and extend beyond the railway for nearly half a mile. The bottom chord of the bridge will be 54 ft. above the highest water mark.

THE BRAZOS JETTY WORK is progressing favorably, as 7,000 lin. ft. are now completed on the two jetties. About 2,000 ft. more are required to complete them, according to an interview with Mr. WILKE, the contractor. The work already done shows an increasing depth of water.

THE CITY COUNCIL OF MONTREAL has passed a by-law to effect a loan of $1,000,000 for improvements in connection with the harbor front, under the authority of the Act passed at the last session of the Legislature of the Province of Quebec. Bonds are to be issued at such periods as may be deemed expedient, not to exceed 40 years from the date of their issue, at a rate of interest not to exceed 3½ per cent. The proceeds of the loan are to be applied to the following purposes: (1) To construct a permanent dyke in front of the city to prevent inundations, $670,353; (2) to widen Commissioners and Common St.. (including cost of filling, macadamizing and purchase of land), $129,647; (3) to construct a tunnel under Bleury St., $163,750; (4) to construct a ramp at Gale St., $23,000; (5) interest and contingencies, $13,250; total, $1,000,000. A vote of the municipal electors will now be taken, and if the by-law receives the approval of the citizens, the loan will be made and the work proceeded with without delay.

THE CHICAGO WATER-WORKS TUNNEL, according to the *Chicago Tribune*, is now nearly 1,200 ft. east of the breakwater, with the land tunnel completely finished. The distance under the lake yet to be tunneled is about 3¼ miles, out of the total of 4 miles. The Assistant City Engineer reports that the progress is about 14 ft. per day in each of the 6 ft. tunnels, and the shaft at the 2½ mile station is progressing slowly, through troublesome sand. It will be remembered that tunnelling was commenced on this work in January, 1887. The two shore shafts were much delayed by encountering a bed of quicksand. At the 2½ mile shaft a cast-iron cylinder 100 ft. in final length is being sunk through the sand. The shaft at the one-mile station is also being sunk, but under difficulties. The two lake tunnels now being driven are each 6 ft. in diameter and are located about 50 ft. apart. The engineer estimates that at the present rate of progress it will require two years to finish the work.

ST. PAUL AND MINNEAPOLIS are looking towards the Mille Lacs, 90 miles north of St. Paul, as a future source of water supply. These lakes cover an area 15 miles square and lie 568 ft. above the level of St. Paul. The water is cold, pure, and blue, and one foot of surface depth will supply 105,000,000 galls. per day. The objection raised is that the watershed is limited and insufficient and that the lakes are liable to dry up with settlement and drainage of the adjacent country. The *Pioneer Press*, however, wisely says it is useless to speculate on unknown conditions, and recommends a thorough investigation of these lakes and the St. Croix River, as a possible means of supplementing the present, and what must shortly prove insufficient, sources of water.

THE GEOLOGICAL SURVEY MAPS OF NEW JERSEY are ordered by the Board of Managers to be sold at the cost of paper and printing; viz. at 25 cts per sheet, either singly or in lots. This amount covers postage or expressage, and applications for maps, with money enclosed should be addressed to Mr. IRVING S. UPTON, New Brunswick, N. J. There are 20 sheets in all, and this opportunity should not be neglected for securing a set of the best State maps ever issued in this country, at the price of $5.00 per set.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a rear collision, Nov. 22, on the Lehigh Valley Railroad near Bethlehem, Pa. A freight train ran into a local passenger train standing in the station. One person was killed and three were seriously injured.——Three derailments, caused by the spreading of the rails, are reported: One Nov. 23 on the Northern Pacific Railroad near Bearmouth, Mont., in which several cars of a freight train were derailed; another on Nov. 23, on the Savannah, Florida & Western Railroad near Albany, Ga., in which the rear Pullman car was overturned, and after having dragged along for some distance rolled down an embankment; the passengers were injured, but none were killed; the third was on the East Tennessee, Virginia & Georgia Railroad, Nov. 26, near Greenville, Tenn.; the engine and several cars were derailed; one man was killed and five were injured. ——A collision occurred, Nov. 21, at Battle Creek, Mich., near the Chicago & Grand Trunk Railroad depot, owing to the failure of the air-brakes on a train of stock cars.——A broken axle caused a wreck on the Pennsylvania Railroad near Falmouth, Pa., Nov. 25; 15 freight cars were wrecked and 8 went into the canal.

BRIDGE ACCIDENTS are reported as follows: The middle pier of the Catawba River bridge of the Charlotte, Columbus & Augusta Railroad at Rock Hill, S. C., has been washed out.——The iron lift bridge over the Erie Canal at West St., Syracuse, N. Y., was wrecked, Nov. 22, by a canal boat; the bridge tender was asleep.——The Western New York & Pennsylvania Railroad bridge at Tuscarora, N. Y., has been damaged by floods.

A LANDSLIDE has occurred recently on the Canadian Pacific Railway near Bison Station in the Cascade Range.——Another has occurred on the Shenandoah Valley Railroad, in Virginia.

THE RAINFALL IN NEW YORK, as observed at the Signal Station, has been 6.27 ins. for the first 28 days of the month. This exceeds any rainfall in November for the last nineteen years, or since the station was established. The next record was in 1877, with 5.48 ins. for the whole month. The total rainfall in New York to Nov. 28 has been a little over 53 ins., which exceeds by 4 or 5 ins. any rainfall in the eleven months since 1870.

THE CLEVELAND, O., TUNNEL DISASTER, it is now charged, was due to a hole purposely cut in the tunnel brickwork by the foreman of a working gang, through which hole quicksands and water entered in quantity sufficient to almost wreck the tunnel. An investigation showed that the brick-work was cut purposely, and this foreman, JOHN O'BRIEN, is stated by city officials to have done this mischief to prolong his own engagement at a high salary. He is said to be under arrest in Cleveland.

HEADLIGHTS on the Pennsylvania Railroad are now required, since Nov. 10, to be concealed by a curtain when the engine stands on side-track. It is an admirable regulation. Under it, the glare of an opposing headlight means something to be at once heeded.

SUPERINTENDENTS OF CONSTRUCTION OF PUBLIC BUILDINGS must hereafter give a bond holding them personally responsible for bad work or bad material inspected and passed by them. Supervising Architect WINDRIM has forced this change because, under the old form of bond, the contractor was released by the approval of the superintendent, and neither contractor nor superintendent could be held answerable, and the Government was compelled to stand the loss by faulty work.

THE NEW U. S. NAVY stands as follows, according to the late report of Mr. THEODORE WILSON, Chief of the Bureau of Construction and Repairs: Four steel cruisers and a steel dispatch boat in commission; the *Baltimore*, *Vesuvius*, *Petrel*, and *Charleston* have had their trial trips, and will soon be ready to go into commission; and there are 21 wooden steamers and 7 iron steamers still useful and serviceable. With the vessels completed, now building and appropriated for, the Government will possess 10 armored vessels, 13 single turreted mon

itors, 21 steel cruisers or gunboats, 2 dynamite cruisers, one practice ship for cadets, an armored ram, 1 first-class torpedo boat, and 7 iron steamers.

THE NEW WAR SHIPS now advertised for include two 1,000-ton cruisers, the Naval Academy practice ship and the Thomas cruiser-monitor. The cruisers are to steam at the rate of 14 knots per hour for 2,452 knots, or at 10 knots for 4,668 knots. They are to be 190 ft. long on load line, 32 ft. beam, draught 12 ft.; and to carry 150 men and a battery of heavy, rapid fire and machine guns.

THE GAS COMPANIES OF NEW YORK have subscribed $28,000 to the World's Fair Fund. This result is mainly due to the personal efforts of Mr. E. C. BROWN, of our energetic contemporary the *Progressive Age*. Mr. BROWN represents the gas fraternity in the Committee on the Fair.

THE ELECTRIC LIGHT IN ROME, and the use of the famed Falls of Tivoli as a motive power for the dynamos, is the latest innovation contemplated in that ancient city.

ELECTRIC WIRES IN CINCINNATI are to be put underground. An order to that effect has been made by the Board of Public Works. It requires approval, however, by the City Council.

A LARGE WATER-POWER DEVELOPMENT SCHEME is proposed near Port Arthur, Ont., at the Kakabekka Falls of the Kaministiquia River. At this point the river falls 100 ft., and the volume of water is such that it is claimed about 200,000 H. P. is available. Mr. THOS. MARKE, of Port Arthur, has sold the property to Messrs. A. M. EASTMAN, of St. Paul, and R. J. ANDERSON, of Minneapolis, who are said to be at the head of a syndicate formed to develop the property.

THE MOST POWERFUL ROLLING MILL ENGINES in the world, according so the *English Mechanic*, are the reversing engines just made by Galloways, of Manchester, for Palmer's Ship Building Co. The engines drive a 44 in. train of rolls. The cylinders are 56 ins. diameter, and 6 ft. stroke, and use steam at a pressure of 100 lbs. The engine is fitted with Joy's valve gear. The crank shaft is built up of mild Siemens-Martin steel, the forgings of which weighed 41 tons before being turned. The finishing shaft has journals 21 ins. diameter, and is of a total length of 23 ft. 6 ins. The total weight of the engines is nearly 300 tons.

FREEZING WATER FOR STORAGE for later irrigation purposes is the last substitute for high dams suggested by an "Idaho engineer." He proposes to form artificial glaciers at high altitudes by some artificial freezing process. A little ice applied to the head of this genius would perhaps be beneficial.

IT has been estimated that more than 400,000,000 human mummies were made in Egypt from the beginning of the art of embalming until its discontinuance in the seventh century. HERODOTUS and DIODORUS agree in the statement that there were three grades of embalming. The first cost, in our money, was about $1,225, the second about $375, and the third was very cheap. Under it, the bodies were pickled for a number of days and then boiled in bitumen. These mummies are devoid of hair and eyebrows, are black, dry, heavy, and very hard to break.

A SWISS MAYOR'S METHOD OF PRESERVING STAKES, as described in the *Freisenigge Zeitung*, will awaken recollections among many engineers. A correspondent of this journal, Mr. H. W. CLARKE, C. E., of Syracuse, N. Y., is responsible for the following translation: "A new road was about to be made in a certain parish in the Bohmerwald. The surveyor came, took his observations, and with considerable care and exertions, staked out the road. When this part of the work was done he went to the mayor of the parish and said, "I must ask you to see that the poles are not stolen over Sunday." On Monday morning the surveyor came back. Sure enough the stakes had gone. The mayor had locked them up for safety in the town hall.

Japanese Flood and Earthquake "Extras."

As showing the methods of the Japanese press in graphically recording, in the form of "extras," events of great national importance, we here reproduce plans and views of the late disastrous floods and earthquakes in Japan. The originals were selected from a number sent to us by Mr. DOMI ZERVAS, C. E., of Tokio, Japan; and we are indebted to the courtesy of the Japanese Consul in this city for the translation upon which the following description is founded:

Fig. 1 is taken from a photograph as published in the Tokio *Asahishimbun*, of Sept. 1. It shows the breaks in the ground, near Signal Gun Hill, in the town of Takahashi. The accompanying text says that this earthquake occurred on the night of July 28, 1889, in the province of Kumamoto Ken, and was one of the most disastrous in the history of Japan, causing a loss of over 2,000 lives The disturbance

Fig. 1. Ground broken by Earthquake of July 28, 1888; near Takahashi, Japan
(From a photograph.)

extended over an area including one large city and nine sectional divisions, or counties. The ground was broken in about 890 distinct places. It was deemed worthy of rank along with the "nine great earthquakes" of Japanese history, to which their historians affix the following dates:—(1) December, 647; (2) May, 733; (3) May, 867; (4) July, 887; (5) November, 1662; (6) November, 1723; (7) September, 1725; (8) September, 1779; and (9) February, 1790.

The remaining illustrations are taken from "extras" issued by the Osaka *Asahishimbun*, of Aug. 31 and Sept. 15, 1889, and relate to the terrific earthquake and floods in Japan of last August, which are reported to have caused the loss of nearly 20,000 people, including in this loss the results of a simultaneous tidal wave.

Fig. 2 is a map of the valley of the Totsugawa River in Nava Ken. It is entitled "The Scene of the Calamity in Totsugawa Village and Vicinity." In this map, the black portion shows the region covered by the water; the circles are small villages; the heavy black lines are roads; and the black triangles point out the villages which suffered most from the flood.

This calamity was accompanied, and in a great part caused, by extensive land-slides from the mountains bordering the streams. Fig 3 graphically shows a slip of this character overwhelming the villages of Yatani and Tsujido. The latter place was a prosperous little town of 28 houses, all of which were destroyed excepting only a Buddhist temple. Fig. 4 is a cross-sectional view of the valley at the village of Yase, which was covered with water to the depth of 300 or 400 ft.

These land-slides, of which there were six of importance, dammed back the Totsugawa River about 5 miles and in some places raised the water and mud to an estimated height of 480 ft. Along the Amanogawa River these dams formed temporary lakes of great depth, and held back the water for about three hours before they broke.

The Bituminous Rocks of California.

We are indebted to Mr. GEORGE F. WRIGHT, M. Am. Soc. C. E., of Santa Barbara, Cal., for the following interesting data concerning the bituminous rock of that section of the State.

This rock is now used for street paving in various cities of California. The so-called Carpenteria rock is found in the lower part of Santa Barbara County. For cellars, stable floors, and warehouses, or places not exposed to the sun, it does very well used pure; but it is of doubtful value for roadways in its simple state. The San Luis Obispo quarries are more extensive than those of Santa Cruz, and the former furnishes now nearly all the paving material used in southern California and a liberal share of that employed in the northern half of the State.

This rock requires no crushing and no mixing of any sort, being simply disintegrated by steam or hot air, generally by the former. The kettles in general use are made in the form of an upright boiler, with a manhole at the upper end for loading and a door at the bottom, on the side, for unloading the charge. A line of grate-bars runs horizontally across the kettle about midway. The rock is broken up by mattocks into pieces, varying from 4 to 8 in. cubes, and thrown into the manhole until the kettle is full, and both manhole and door are then screwed shut, and the steam is turned on. At Los Angeles the steam is superheated, but this is not the general practice. The rock disintegrates with the heat and falls into the lower compartment of the boiler. One charge of about three tons required about four hours to thoroughly "cook," with steam at 100-lbs. pressure.

When the steam is turned off, the disintegrated rock is shoveled into wheelbarrows and landed on the street. The remaining treatment is practically the same as with ordinary asphalt paving, except that this bituminous rock will not compress under rolling much, if any, more than 10 per cent.; that is, after the small hot rollers have finished, the large 10-ton roller gives no further appreciable compression. On this account the steam work roller is generally omitted on finished surfaces.

In Santa Barbara, State St., 56 ft. wide between curbs, is practically paved for two miles of its length with this rock. The foundation was made of cobble-stone, hand laid, with sand swept over the surface. A thin layer of broken rock was then spread over the cobbles, and rolled with a steam roller until the mass was thoroughly wedged together; then the final layer of broken rock was spread and brought to the street form, and again rolled. On this surface one inch of Carpenteria was next spread and heavily rolled with the steam roller; and finally a wearing surface of San Luis Obispo rock, 1½ in. thick, was applied. The total thickness of the roadbed thus made was 2½ ins. of bituminous rock on 9 ins. of cobbles and broken stone

The writer abandoned concrete under protest, but by the direct order of the City Council.

The maximum grade on the street is 4.08 per cent. for one block; 2 to 3 per cent. grades are common. The contractor gave bonds to keep the street in repair for five years, free of cost to the city. The work was completed on Sept. 1, 1888, and the first block opened to travel in April of 1888. The street has stood well in all parts, the only weakness being along the curbs where the grade is light. Urine seems to kill the strength of the material, if it can get time to work on it.

The contract price for finished pavement, exclusive of grading, was 20 cts. per sq. ft. ($2.16 per sq. yd.), including the five years' guarantee. The highest temperature in Santa Barbara is 105° Fahr.; this has failed to soften the pavements so that it would stick to the shoes or hand. A heavily-loaded, narrow-tired wagon makes a crease in warm weather, but leaves no permanent mark. Cold weather does not exist in that section, but the writer does not think that this pavement would be as slippery as ordinary asphalt.

The condensed steam and hot water, used in the disintegration of the rock, did not appear to have any injurious effect on the extra wet portions, as noted in subsequent examination. Los Angeles has miles of this pavement, in good order under heavy traffic.

An analysis of this bituminous rock, as made by Mr. THOMAS PRICE, of San Francisco, is also submitted; and an abstract of this official report is as follows:

The San Luis Obispo Rock consists of :	
Sand in a very finely divided state,	85.3 per ct.
Hard, firm and elastic asphaltic material,	14.4 "
Water and loss	0.4 "
	100.0 "

The asphaltum, which is the binding material, contains a small quantity of paraffine, and yields on distillation as follows, the percentages being calculated on the crude material:—

Between temperatures of 270° and 400° Fahr. a dark colored coal oil	= 1.25 per cent.
Between 400° and 540° Fahr. a heavy thick oil.....	= 2.65 " "
The balance is a firm, elastic and cohesive asphalt.....	= 9.35 " "

On heating to 110° Fahr. the material retains both its hardness and elasticity; at 120 ° Fahr. it softens somewhat, but is still sufficiently elastic for a road way; but at 130° Fahr., it softens and disintegrates.

The Carpenteria rock, from Santa Barbara Co., Cal., is made up as follows:—

Sand.....	84.2 per cent.
Asphaltic material	14.9 "
Water and loss	0.9 "
	100.0 per cent.

The sand in this rock is much coarser than that from San Luis Obispo, and the asphaltic material is softer and less firm and elastic. On distillation this Carpenteria bitumen yields as follows, with percentages based on crude material :

Between 240° and 400° Fahr., a light-colored coal oil	= 3.25 per cent.
Between 400° and 540° Fahr., a heavy black oil.....	= 4.40 "
Balance, a firm elastic asphalt, as before	= 7.25 "

It is the large proportion of oil in this rock that renders it less firm and elastic than that from San Luis Obispo.

The Carpenteria is somewhat friable and is lacking in cohesive qualities at 65° Fahr. At 75° Fahr. it softens very materially and becomes still more friable; at 85° it becomes softer, and at 100° it becomes extremely soft and disintegrates.

Mr. PRICE adds that both samples are quite different from the bituminous stone from Val de Travers and from those of Europe and Asia generally. The European and Asiatic materials are composed of finely divided calcareous material, the asphalt having been absorbed into the very pores of this limestone, and really forming part of the rock itself. When heated, there is no separation of the ingredients unless the temperature be so high as to distill over the oils. In the California bituminous rocks, we have grains of sand cemented together by the plastic asphalt, there being no absorption of the asphalt into the body of the material, each being separate and distinct.

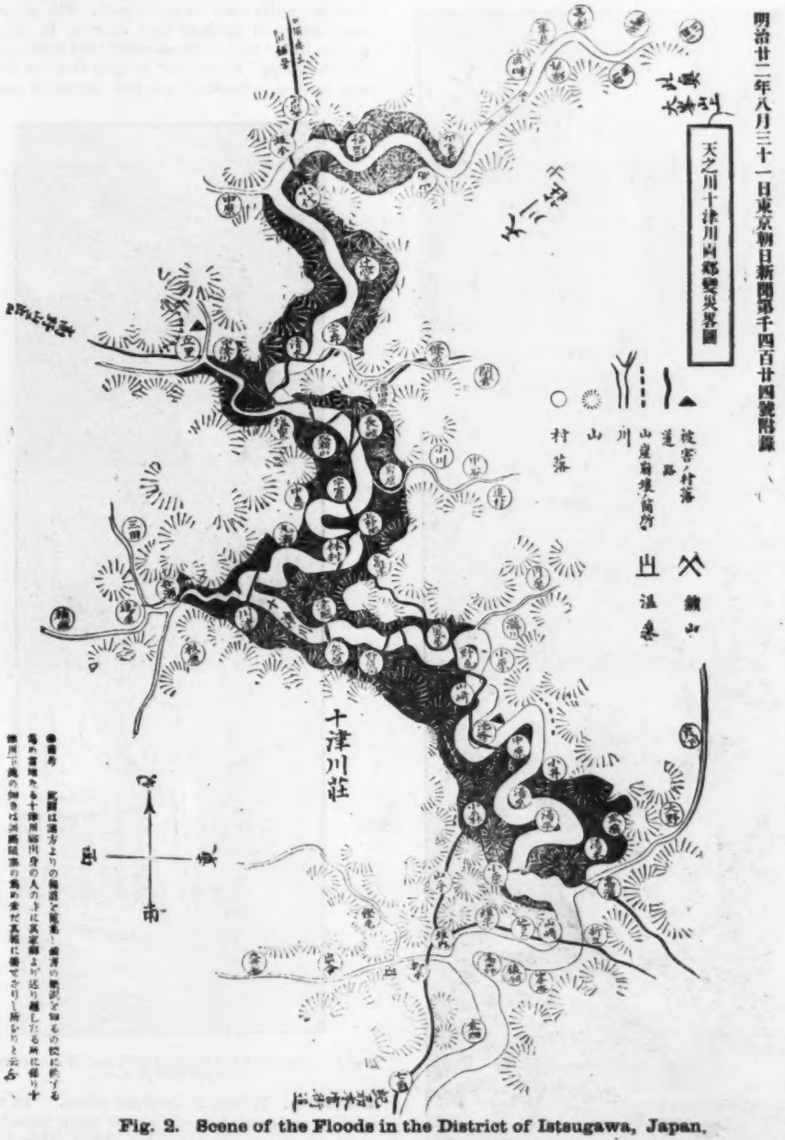


Fig. 2. Scene of the Floods in the District of Istsugawa, Japan.

The Proposed Du Viaur Viaduct.

(With Inset.)

Among the models exhibited at the Paris Exposition is one of a bridge designed for crossing the valley of the Viaur, on the railway from Carmaux to Rodez. The plan and the following description of this work are taken from *Le Génie Civil*.

A commission of inspectors general and engineers in chief of the *ponts et chaussées* appointed for the examination of plans submitted by various designers, selected that of the *Société des Batignolles*. The Minister of Public Works has approved of this finding, and the party named has been directed to proceed with this important work.

The plan here given shows a metallic structure made up of two half-girders united by a central hinge. Each of these two main members has the form of a triangle in which two sides are curved and the "apex" or point opposite the straight side is at the bottom. These half-girders spring from masonry piers carrying hinged connections. The ends of the girders, which may be said to corbel out back of the springing point, support the one end of a truss which has its other end resting upon a rear abutment. The purpose of these connecting trusses is to provide for the slight movement which may take place in the shore-ends of the main half-girder.

The two girders are inclined longitudinally towards the axis of the bridge, so as to give the wide base at the springing points necessary for the stability of the structure. The cross-sectional views show the girders for supporting the road-bed and line of rails and also the system of lateral bracing.

The advantages claimed for this novel system of construction are as follows: (1) The three hinges enables the stresses to be exactly determined; and the arrangement of the members is such that there can be no doubt concerning the actual work performed by each one. (2) During erection and in service there can be no other strain developed than those arising from the dead weight, vertical loads, and wind pressure. (3) The hinge at the crown enables the arch to be keyed without difficulty, and this is accomplished without establishing in other parts of the structure abnormal stresses difficult to determine, like those produced in arches continuous at the crown. (4) The part of the triangle to the rear of the springing points decreases the stresses, better distributes the work of the curved members, and facilitates the erection of the structure. During the erection of the central portion, the arch is held in equilibrium, partly by the weight of the rear section and partly by anchors. (5) On account of the hinges, variations in temperature have no injurious effect in varying the work performed by the girders.

All possible deformation of the members of the bridge or in the road bed have been carefully studied, under the action of vertical loads, wind pressure and variations of temperature. They are very slight and are less than those in the large bridges

of similar type now elsewhere existing. The proportions are such that the arch cannot open at the crown under the most violent wind pressure; but to remove all apprehension on this point, the arch-segments are connected at the key by rods so arranged as not to interfere with the articulation.

The principal dimensions of this bridge are as follows:

Total length of structure	1508.8 ft.
Length of metallic portions	1344.8 "
Clear central span	820.0 "
Side spans, each in total	262.4 "
Height of rail above bottom of valley	382.1 "

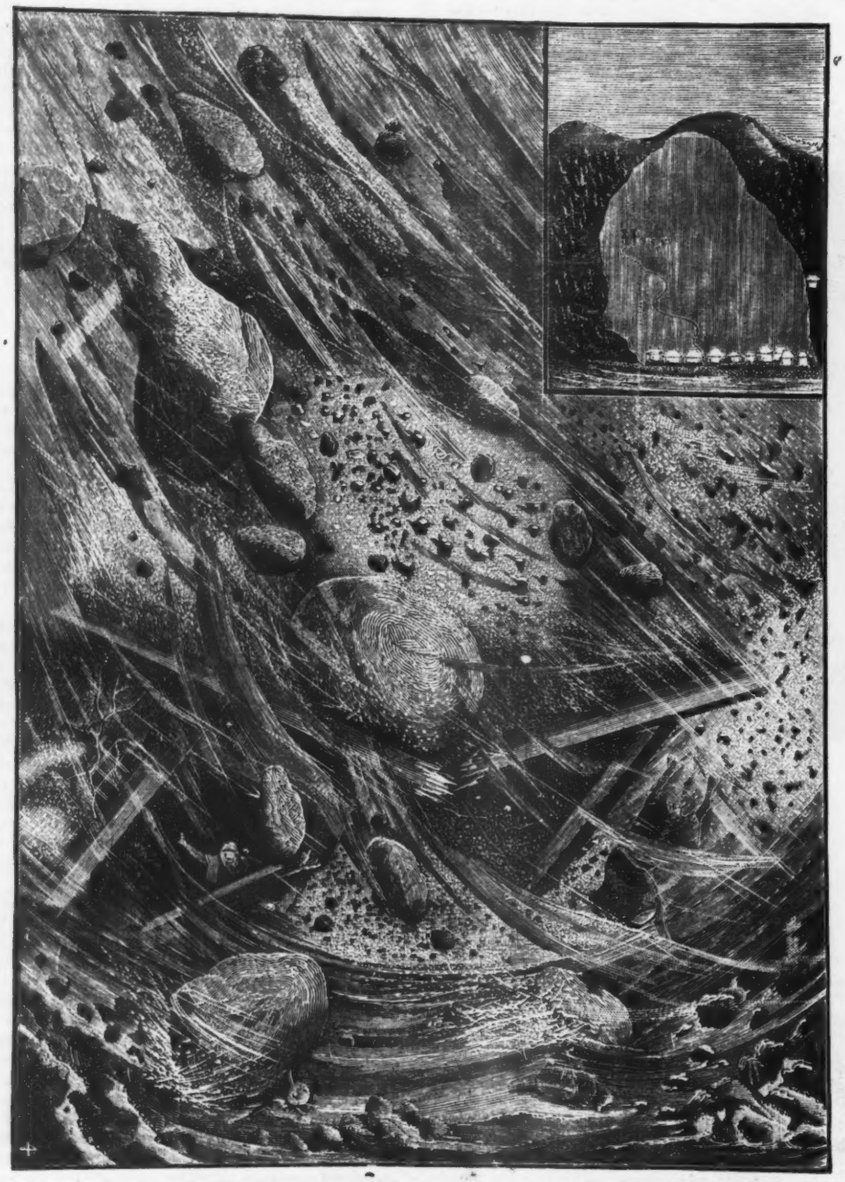


Fig. 3.—Land-Slide overwhelming the Villages of Yatani and Tsujido.
(The small view in the upper corner shows the path of the slide and the one temple that was saved.)

This central span of 820 ft. is the greatest in France. The famed Garabit viaduct has a main span of only 541.2 ft. and the distance from the rail to the valley bottom is about 300 ft. The Forth Bridge, in Scotland, with its spans of 1,700 ft. between the axes of the piers, of course, far exceeds the dimensions of this proposed Viaur viaduct.

SILK FROM WOOD-PULP was one of the exhibits at the Paris Exhibition. This is the process of M de CHARDONNET, of Lyons. The fiber is produced from a nitrated cellulose obtained from wood pulp by a secret process. This artificial silk is said to be perfectly uniform in thickness and perfectly round in section; it can be dyed any color and interwoven with cocoon silk in manufactured goods.

Comparative Value of Heart and Sap Pine.*

A young Southerner, now dead, noticing, about five years ago, that no short-leaved pine was shipped from the South to New York, resolved to introduce this wood into that market. At first, dealers there would not buy what they termed, "worthless tapped bastard pine." It was known as North Carolina pine. It was only after the young man referred to advertised it and represented it as "untapped Virginia pine" that it could be sold. The quotations in the lumber trade papers of four years ago are all given under the heading of "Virginia pine." There is something in a name in trade, if not in SHAKESPEARE'S roses. This is true in the professions, too. The name of sap-pine, rightly condemned for its early decay, is condemned by the civil engineer for every other consideration. The name of heart pine, rightly praised for its durability, is praised without reserve for every other consideration.

Facts are stubborn things, and the fact that sap-wood has its merits has stubbornly intruded itself into the minds of wood-users of the North during the past five years, in spite of deep-rooted prejudices; and from an unrecognized trade in sap-pine five years ago, we find that in the past year at least 100,000,000 ft. of short-leaved or sap-pine has been used in and about the city of New York. This supply has taken the place at first chiefly of spruce, then of heart-pine, and lastly of white pine and poplar. But apropos of our subject, the manufacturers and dealers in long-leaved or heart-pine freely admit that the introduction of short-leaved pine in the New York market has curtailed their sales there very considerably.

Why have not the merits of sap-wood been more generally recognized before? In Norfolk and Richmond, Virginia, and in Washington, Baltimore, and as far north as Philadelphia, short-leaved pine has been generally used for years past. The writer has seen sap-wood timbers and flooring in very old houses intact and sound as when they were put into the buildings. It need not be said that the lumber was securely protected against excessive wetting and drying. It was in its right place. The users of that sap-wood lumber would have joined the great army of abusers had they placed the same for ground-sills to their houses. If seasoned sap-pine is properly protected against the destructive effect of alternate wetting and drying, it will last as long as though the wood were from the heart of the tree. In protecting sap-wood, a free circulation of air must be provided for, and hence when a covering is put about timbers, the ends, at least, should be left exposed to the air, or the wood will become subject to the most dangerous of all defects, dry-rot. This is, however, true of heart-pine also. In either case the only empirically demonstrated complete protection against alternate wetting and drying, is the injection into the pores of the wood, by pressure, of a sufficient quantity of what is known as creosote oil. The wood should first be heated and all the albuminous sap extracted as far as possible, by creating a vacuum in the cylinder in which the wood is placed for creosoting. The more thoroughly and uniformly the creosote can be distributed through the wood,

Fig. 4.—The Flooded Village of Yase; Water between 300 and 400 ft. Deep.

*Written for ENGINEERING NEWS by RICHARD LAMB, C. E.

COMPILED IN THE OFFICE OF LAMB & BELL, NEW YORK, FROM FACTS TAKEN FROM THE FORESTRY REPORT OF THE TENTH CENSUS OF THE UNITED STATES.

Name.	Where found	Extent of growth.			Weight.			Strength.				Texture.	Color.	Sap-wood.	Uses.
		Height in meters.	Diameter in meters.		Per cu. ft. in lbs.	Specific gravity.		Coefficient of elasticity kilograms on millimeters.	Ultimate transverse strength in kilograms.	Ultimate resistance to longitudinal crushing in kilograms.	Resistance to indentation to 1.27 millimeters in kilograms.				
Pinus palustris... Long-leaved pine Southern pine ... Georgia pine ..... Yellow pine ..... Hard pine	Southeastern Virginia, south to Cape Canaveral and Tampa Bay, Florida, and through the Gulf States to the valley of the Red River, Louisiana, and the Trinity River, Texas, rarely extending beyond 150 miles from the coast.	18 to 29	0.60 to 1.20	Heavy	43.62	0.6990	Very strong. durable.	1,488	490	10,174	2,508	Exceedingly hard, tough, coarse-grained, compact, bands of small summer cells; broad, occupying fully half the width of the annual growth; very resinous; resin passages few, not conspicuous; medullary rays numerous, conspicuous.	Light red or orange; sap-wood nearly white.	Thin.	Largely manufactured and used in construction of all sorts; for shipbuilding, fencing, railway ties, etc. The turpentine, tar, pitch, resin, and spirits of turpentine manufactured in the United States are almost exclusively produced by this species.
Pinus mitis..... Yellow pine..... Short-leaved pine Spruce pine . ... Bull pine	Staten Island, New York, south to the Chattahoochee region of western Florida, through the Gulf States to Tennessee and eastern Texas, and through Arkansas to the Indian Territory, southeastern Kansas, southern Missouri, and in Union County, Illinois.	24 to 30	0.60 to 1.35	Heavy	38.40	0.6104	{Strong.	1,375	443	7,628	2,064	Varies greatly in quality; hard generally coarse-grained, compact bands of small summer cells; broad, often occupying half the width of the annual growth; very resinous; resin passages numerous, large; medullary rays numerous, conspicuous.	Orange; the sap-wood nearly white.	Varying greatly in amount of sap.	Manufactured into lumber, and among yellow pines only inferior in value to that of *Pinus palustris*.
Pinus resinosa.... Red pine..... Norway pine.....	Newfoundland, northern shores of the Gulf of St. Lawrence and Lake Nipigon to the valley of the Winnipeg River, south through the Northern States to Chestnut Hill, Middlesex County, Mass., the mountains of northern Pennsylvania, Isabella County, Michigan, and central Minnesota.	24 to 46	0.60 to 1.37	Light	30.25	0.4854	Not strong	1,132	341	7,274	1,353	Hard, rather coarse-grained, compact; bands of small summer cells broad; very resinous; resin passages few, small, not conspicuous; medullary rays numerous, thin.	Light red, the sap-wood yellow or often almost white.		Largely manufactured into lumber and used for all purposes of construction, flooring, piles, etc.
Pinus taeda..... Loblolly pine..... Oldfield pine ..... Rosemary pine...	Southern Delaware, south to Cape Malabar and Tampa Bay, Florida, generally near the coast, through the Gulf States to the valley of the Colorado River, Texas, and north through southern Arkansas to the valley of the Arkansas River, springing up on all abandoned lands from Virginia southward.	24 to 46	0.90 to 1.50	Light	33.91	0.5441	Not strong Not durable.	1,128	377	6,834	1,719	Brittle, very coarse-grained; bands of small summer cells broad; very resinous, conspicuous; resin passages few, not prominent; medullary rays numerous, obscure.	Light brown, sap-wood orange or often nearly white.	Very thick sap-wood.	Largely used for fuel, and manufactured into lumber of inferior quality. Turpentine is occasionally manufactured from this species.
Pinus rigida..... Pitch pine.....	Valley of the St. John's River, New Brunswick, to the northern shores of Lake Ontario, south through the Atlantic States to northern Georgia, extending to the western slope of the Alleghany Mountains in West Virginia and Kentucky.	12 to 24	0.60 to 0.90	Light	32.10	0.5151	Not strong	5,581	316	5,667	2,123	Soft, brittle, coarse-grained compact; bands of small summer cells broad; very resinous, conspicuous; resin passages numerous, not large; medullary rays numerous, obscure.	Light brown or red, sap-wood yellow or often nearly white.	Thick sap-wood.	Largely used for fuel, charcoal, and occasionally manufactured into coarse lumber.

the better is its condition for resisting any external change of humidity, and hence the better fortified against decay. It is generally accepted as true among all parties engaged in creosoting wood, that the best results can be far more easily and satisfactorily obtained in treating sap-pine than in treating heart. The great difference in the resistance of the heart of the wood to the impregnation of the creosote causes it to be unevenly distributed. Sap-wood, on the other hand, admits a satisfactory distribution of the oil. When both woods are treated properly with creosote, there is no advantage of the one over the other in condition for durability.

But creosoting is not always available, and hence the durability of sap-pine as compared with heart-pine must be considered independently of artificial or foreign preservatives. There are ten species of what we might term, for convenience, yellow pines of the eastern United States. Their scientific names are: *Pinus cubensis, Pinus palustris, Pinus mitis, Pinus clausa, Pinus inops, Pinus sexotina, Pinus rigida, Pinus taeda, Pinus ponderosa, and Pinus resinosa.* The writer has compiled from the Tenth Census Report on the Forestry of the United States the principal attributes, properties, etc., of five of the above woods which we wish to consider. With the exception of *Pinus resinosa*, the woods chosen for consideration are common to the Atlantic seaboard States from Virginia southward through Florida. The northern wood, *Pinus resinosa*, is tabulated with the others be cause it comes in direct competition with the wood *Pinus mitis* in the New England market, and they are very similar in appearance, and their physical differences are not generally known. The superiority of the *Pinus mitis* over the *Pinus resinosa* in every point of comparison is obvious on inspecting the accompanying table. We therefore will make no comments upon their comparison.

The woods *Pinus taeda* and *Pinus rigida* have been tabulated with the others in order to define more specially the wood known in the trade as North Carolina or Sap Pine—*Pinus mitis*. We have chosen these two as being more commonly found in the districts where lumber from the wood *Pinus mitis* is made. It is the fact that these woods are found in the same region, that condemned former attempts to introduce sap pine in the New England market. We might qualify the above statement by coupling with that cause the fact that manufacturers did not grade and season their lumber as they do now before shipping to the North. Its rejection, however, was primarily caused by a prejudice against sap wood; and secondarily, it was objected to because of its quality. Timber cut from lands adjacent to tide-water streams of Virginia often proved of very inferior quality, it being cut from trees of the species *Pinus taeda*. These forests have sprung up from the abandoned plantations of our colonial fathers, which naturally were situated on lands located convenient for water transportation.

The writer has been through a large forest of *Pinus taeda* on the old Berkeley Plantation, better known as Harrison's Landing, James River, Virginia. The land of this forest shows distinctly the parallel furrows and hills of the abandoned plowed fields of perhaps Lord BERKELEY, or if of more recent origin, of the first President HARRISON. Often near these forests can be found other forests of original growth. These are the trees of the species *Pinus mitis*. They can be distinguished by the possession of a smoother bark, with a more life-like reddish-brown color to it. The *Pinus taeda* has a very thick and scaly bark, which is of a dead-looking grayish-brown color. This wood is known to firewood or cord-wood dealers as "second growth." The *Pinus mitis* is called in that trade "original or first-growth" wood and brings fifty cents per cord more than the "second-growth" wood. The ravages of the wood-hewers will ere long entirely destroy these forests. Each year there is shipped from Virginia to New York 30,000 cords of this wood. The inferior quality of the wood makes it unprofitable for manufacturing into lumber, and it pays better to cut the forests for burning wood. Hence we see but few of the lumber mills situated so as to cut the forests of tide-water Virginia. They will be found either ten or twenty miles inland or at situations where they can secure logs from the interior forests or from tide-water North Carolina. A careful comparison of the two woods in the accompanying table will satisfy the reader that the *Pinus mitis* wood is far superior to the *Pinus taeda*.

We will not go into the details of the comparison of *Pinus mitis* with *Pinus rigida* wood. A study of the accompanying table will show the superiority of the former over the latter wood.

As the bulk of timber shipped as North Carolina or short-leaved pine is made from the wood *Pinus mitis*, and as bills can always be had exclusively of this species of pine, we will narrow our comparison down to this and the wood *Pinus palustris*. The two trees can be distinguished the one from the other by the long straws of the long-leaved pine and the short straws of the short-leaved pine. The former also has a much larger burr. Some day some enterprising Yankee will introduce these pine burrs as kindling for fires. The burrs make a large flame and burn for a long while, and are nicely shaped for draught. They are ornamental and clean, and would adorn a parlor if placed in the artistic wood-baskets often seen beside open fireplaces. Burrs are used in some of the European countries for kindling.

When the term "sap pine" is used in future in this article the reference will be to the *Pinus mitis*, and when the term "heart pine" is used, *Pinus palustris* will be meant. This is done because in the first-named wood the trees are nearly all sap-wood, and in the latter they are nearly all heart. It is difficult to get a bill of heart short-leaved pine of ordinarily large dimensions. When it is procured the wood proves superior to the heart lumber of the long-leaved pine as a rule. A Southern engineer of long experience told the writer that in building bridges he secures all heart bills of short-leaved pine. He finds it difficult to secure them, and pays more for the lumber. This he does because it is his only surety against the lumber not having been boxed or tapped for rosin. The stereotyped specification for pine lumber of civil engineers is, "best all heart, untapped, Georgia pine." Lumber dealers who deal in long-leaf pine generally read that specification: "good merchantable heart pine." In the first place, if the timbers are to be of large dimensions, it is almost impossible to get them entirely free from sap-wood. Is it not all that we can expect or demand, that the timber shall contain only such an amount of sap wood that when same shall have decayed it will not impair materially the efficiency of the stick for the purpose for which it is to be used? In the second place, it is an exceedingly rare ocurrence that a delivery is made of untapped long-leaved pine. Take the State from which you wish your lumber to come, Georgia, quoting from the United States Census Report, under the heading of "Georgia." "The mercantile pine in the immediate vicinity of the principal streams and along the lines of railroad has been removed, and serious damage has been inflicted upon the pine forests of the State by the reckless manufacture of naval stores. The boxed areas include nearly all the regions from which any pine has been removed and extend beyond them in all directions into the uncut forests and along rivers and railroads." Naval stores have been manufactured in Georgia ever since 1842. In 1880, Georgia produced 3,151,500 galls. of turpentine and 277,500 barrels of rosin. Some trees are scarfed for twenty or more years. They thus become a continual source of revenue. The capital necessary to prosecute the business is insignificant compared with that required for making lumber, and their stock in trade, the forests, are entirely consumed in the latter business.

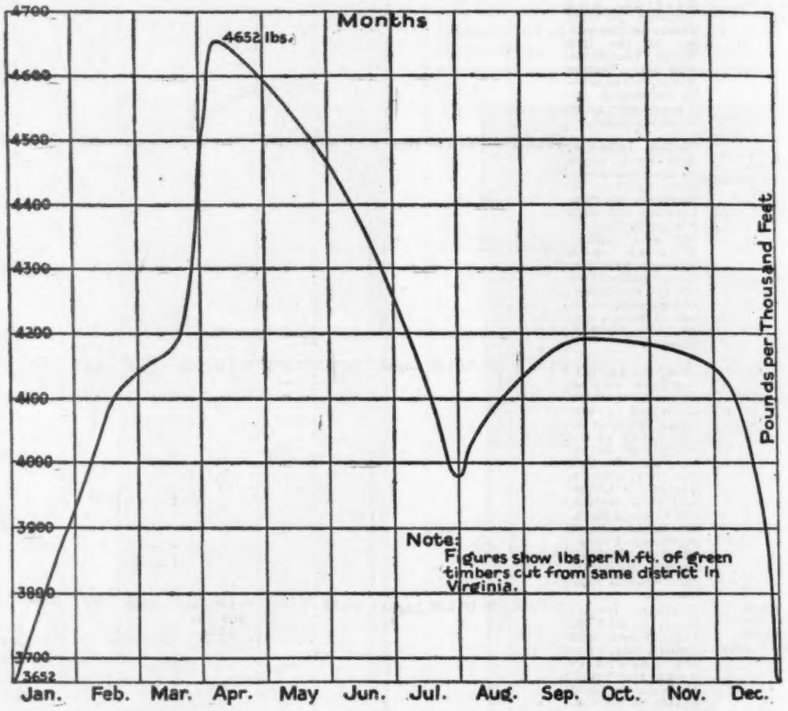


Diagram showing the Flow of Sap in Pine (*Pinus Mitis*) throughout One Year.

The naval-store industry is chiefly carried on by impecunious, illiterate men, who rent boxes from the owners of the forests for a percentage of the profits. A man will contract to clear or burn off the underbrush, leaves, and burrs from around* the trees, to prevent uncontrollable forest fires, and to scarf, make boxes, and dip the spirits and rosin from a certain number of thousand trees, and allow the owner of the forest so much per box, or a certain percentage of the profits. It is a great oversight that these careless contractors are allowed to tap infant trees—many of them not being over 6 ins. in diameter. The writer has noticed that trees scarfed when small have their growth stunted, if not entirely stopped. In fact, there is but little doubt that the growth of a tree of any size is stunted by being tapped. It is reasonable to infer from the nature of the growth of trees, that any obstruction to the rise of the sap hinders their growth. The practical question to the engineer is: Does tapping a tree injure it for constructive purposes? Yes and no.

It depends upon what part of the tree the timber to be used is cut from. The writer believes that short-butt logs are not injured. They are made more durable and heavy by having rosin accumulated in the pores. It is most probable that top logs are injured in strength and durability as rosin is drawn from the same to the butt logs. Out of fifteen specimens of *Pinus palustris*, tested by the census officials, an average specific gravity of 0.6999 was determined. Four of these specimens were cut from trees that had been boxed for turpentine from two to ten years. Their average specific gravity was 0.8106. The average specific gravity of the remaining eleven specimens was 0.6596.

(TO BE CONTINUED.)

*It benefits the forests of long-leaved pine to burn around them each year, and nature has made a wonderful provision to preserve the little saplings from being consumed by fire. They spring up from the ground to the height of one or more feet, with a stout stem covered with green leaves or straws. These straws are filled with incombustible matter that puts out the fire and preserves the greater part of the leaves from being burned.

The Aerated Fuel Company's System of Burning Crude Petroleum.

The enormous production of the Ohio and Pennsylvania oil wells has for some years kept the price of crude petroleum down to a point at which for many purposes it can compete with coal as a fuel. The obstacles in the way of the general introduction of crude oil for many purposes to which it is applicable, however, have been sufficient to make its growth in favor rather slow, notwithstanding the numerous forms of apparatus which have been invented for burning the oil.

The system which has been perfected by the Aerated Fuel Company, of Springfield, Mass., seems to avoid many of the rocks on which other systems have split; and it has now been introduced in a large number of plants with manifest success.

Among the desirable features in a plant using crude petroleum as fuel are safety, cleanliness, simplicity, economy, both in first cost and cost of maintenance, and last, and by no means least, such an arrangement of the apparatus that other fuel may be substituted in case the necessity for so doing may arise.

The cardinal feature of the Aerated Fuel Company's system is the use of compressed air to atomize the petroleum jet and secure a thorough mixture of the fuel with the air, thus producing an intense heat, and burning the fuel with but little excess of air over the quantity required to furnish oxygen for combustion.

The general arrangement of a typical plant equipped by this system is shown in Fig. 1. The oil supply is contained in a tank which is set at a lower level than the burners to be supplied. From this tank the oil is pumped up into the pipes which lead to the several burners; but the apparatus is so arranged that the oil cannot possibly rise in the pipe above the level of the dotted line. It will be seen, therefore, that there is no possibility of the oil leaking to the burners when the apparatus is not in operation, as may be the case when the oil flows to the burners by gravity.

The force relied on to lift the oil to the burners is pressure from the compressed air. As seen by the engraving, the pipes from the air-compressor lead to each burner and also to the oil reservoir below the oil pump, thus keeping the oil in all the pipes a

a uniform pressure. In Fig. 2, which is a sectional view of the burner, the manner in which the compressed air forces the oil from the burner may be seen. The handle opens by one movement both the cock in the air pipe from above and the cock in the oil supply pipe from below. The small opening at the apex of the burner is the only place where the compressed air can find vent, and it rushes out at that point, forcing with it a spray of oil forced up in the oil tube by the pressure of the air on the surface of the oil. The handwheel shown, serves to move the mouth of the small oil tube nearer to or farther from the orifice of the burner, and by it the proportions of oil and air issuing from the burner may be regulated. If too much oil escapes, the jet will burn with a smoky flame; while if the air supply is in excess, the flame grows thin and weak.

The pressure of air used is from 10 to 30 lbs. per sq. in., according to the work to be done, the character of the plant, etc. The oil tank may be located at a considerable distance from the buildings where the burners are used to secure greater safety. For small plants, where it is not desired to go to the expense of an oil pump, a reservoir is furnished, capable of holding a day's supply without the variation in level becoming great enough to interfere with the operation of the apparatus.

One very excellent feature of the system is that the burners are located at the side of the furnace and project into it but a short distance. In changing plants which have been operated with coal to use this system, no change in the furnace arrangements is necessary or desirable. The grate bars and furnace may be left exactly as before; and in case the stock of oil should run low, or for any reason it should be necessary to stop the use of oil for a few days, coal may be burned the same as before without removing or changing the oil-burning apparatus. This will be an especially valuable feature in case, after many years, our supply of crude oil becomes scarce and its price is raised to a point at which it will no longer be economical to use it. This, however, seems to be a very remote contingency.

As regards the relative economy of coal and oil fuel for steam-making, tests were made two years ago on a steam boiler, locomotive type, in the Boston & Albany Railroad shops, at Springfield, Mass., and were reported in the "Journal of the Engineering Society of Lehigh University." The results of the test were briefly as follows:

1 lb. oil contains 20,000 heat units; 1 lb. coal contains 12,000 heat units.

Per cent. of heat in coal transferable to water 70 per cent.; per cent. of heat in oil transferable to water 60 per cent.

If we let C = price per barrel of oil, containing 42 galls., weighing 7.3 lbs. per gall., and let T = price per ton of coal, we shall have under the above conditions:

When $3.44\,C = T$, coal or oil may be burned with equal cheapness. When $3.44\,C > T$, it is cheaper to burn coal. When $3.44\,C < T$ it is cheaper to burn oil. From these formulas the following table is made, showing at what prices coal or oil might be used as a fuel under steam boilers at the same cost of fuel:

Price of oil per barrel	*Price of coal per ton, to be as cheap as oil.*
$ .80	$2.75
.90	3.10
1.00	3.44
1.10	3.78
1.20	4.13
1.30	4.47
1.40	4.82
1.50	5.16

The oil used was a fair grade of crude petroleum The quality of coal is not stated, but we judge it to have been about the average in use for steam making. Of course the table is only useful for a rough approximations, since the heating qualities of the coal available in different localities vary between wide limits.

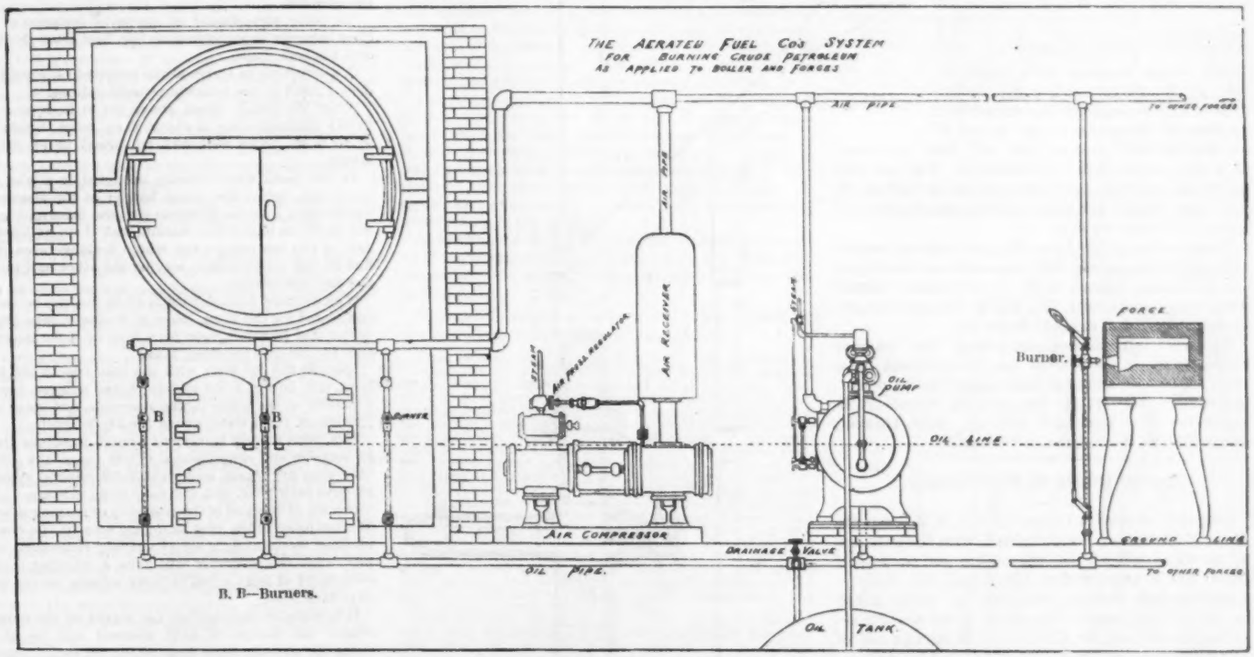
It is to be remembered, however, that the first cost of fuel is only one item entering into the total cost of the steam raising; and since the cost of firing by this system is much less than where coal and ashes has to be unloaded, stored, and shoveled to and from the furnace, the gain in economy is more considerable than would appear from the above.

A point of some importance is made by the company regarding competing systems which use a jet of live steam to spray the petroleum. It is claimed that less steam is used to work the air compressor used with this system than is used for the steam jet. On theoretical grounds, too, we should expect the steam generated per pound of oil to be greater with a compressed air jet than with a steam jet. The latter does not supply the oxygen for combustion, but serves actually to cool the flame and absorb quite a percentage of its heating power.

The place where the economy of oil fuel over coal is most manifest, however, is in furnaces and forges. Here a local heat of great intensity, capable of exact regulation, is desired; and this system of using petroleum seems to attain this desired end very well. The workman is not obliged to spend time poking his fire or waiting for his work to heat. He can regulate it to a nicety by turning a screw; and when not in use, by one movement of a handle the drain upon the oil supply is shut off. For glass melting, pottery works, and places where cleanliness and freedom from sulphur are important considerations, crude petroleum has been able to compete even with gas fuel; and its advantages to those works unable to secure natural gas at a low price are manifest.

In railway repair shops this system finds many applications. Not the least recommendation is its compactness and great convenience. The burners can be set on benches, or anywhere a pipe can be led, and the fire can thus be brought close to the work. In bridge shops the system has been introduced into the shops of the Dominion Bridge Co., at Lachine P. Q., the Berlin Bridge Company's shops at East Berlin Ct., and the Boston Bridge Works.

An objection which has often been made to petroleum fuel is the offensive odor which accompanies its use. The managers of the Aerated Fuel Co. claim to have almost entirely overcome this. They say that the combustion at the burner is so complete that there is no dripping or loss of oil unburnt, and the furnace is as clean and inodorous as one using gas. There is a slight odor at the oil pump, which can, however, be pretty much obviated by keeping the joints perfectly tight. If it is wished to have absolutely no odor about the pump, we should think it would be an easy matter to put a hood over it with a ventilating pipe leading out-doors, and induce a current in the pipe, either by turning into it the exhaust steam from the pump, or if run by a belt, by a very fine jet from the compressed air pipe.



The Aerated Fuel Company's System of Burning Crude Petroleum.
Fig. 1. Arrangement of Plant for Heating Boiler and Forge.

The testimony of various users of the system seems to confirm the statement of those interested in its introduction that there is not enough odor to make the system objectionable.

As to the fire risk under this system, the Home Insurance Co., of New York, has approved of the system as used at the Upson Nut Company's works at Cleveland, O., where over 80 burners are in operation. The Boston Manufacturers' Mutual Insurance Company's experts, in a special report, dated August, 1888, said, "The hazards attending the use of petroleum as a fuel are largely of a controllable nature, and are dependent almost entirely on the precautions taken in regard to its storage and use." The safety of the system as applied to the boilers of the U. S. Cartridge Co., at Lowell, Mass., has been attested by the Hartford Steam Boiler Inspection Co."

The expense of putting in this system varies of course with the class of work to be done, the capacity of the plant and other details. An air compressor costs from $80 upwards; an oil pump costs about $135; storage and supply tanks may cost $200 or more. The Lima crude oil in tank cars in the vicinity of New York costs about 2½ cent per gall.

The best data in regard to the expense of the system in operation are given by those who have plant equipped with it. At the Boston & Albany shops at Springfield the oil is used for steam mak-

ing under the stationary boilers and in the furnaces in the blacksmith shop. Coal can be had at a low price compared with what is charged to private consumers, but it is estimated that $50 per month is saved by the use of oil.

At the U. S. Cartridge Company's shops at Lowell, Mass., a test was made on Oct. 17, 1889, with oil fuel as follows:

Used 195 galls. of oil at 2½ cts.	$4.88
Viz:—	
3 cylinders 26 hours, 52 galls.	1.30
2 lead kettles, 23 hours, 23 galls.	.58
1 forge, 10 hours, 10 galls.	.25
1 boiler and 3 burners	2.75
(11¾ hours, 5 A. M. to 5.45 P. M., 110 galls.)	$4.88

With coal fuel a year ago the fuel bill was as follows:

Used 2,334 lbs. coal at $6 per ton (2,000 lbs.)	
Viz:—	
Boiler 1,500 lbs. in 13 hours	$4.50
3 cylinders 500 lbs.	1.50
2 lead kettles 334 lbs.	1.00
	$7.00
Cost of oil	4.88
Saving in fuel cost by use of oil	2.12

For steam raising, tests made by Mr. E. P. HOLLY, while superintendent of the Springfield Gas Light Co., showed an evaporation per pound of oil of 17,306 lbs. of water from 40° Fahr. to steam at 50 lbs. pressure above atmosphere. The test was made on five tubular boilers rated at 100 H. P. each, and lasted six hours, during which time 417 galls. of oil were burned.

Tests at the D. E. Jones Works, a shovel manufactory at Gananoque, Ont., showed a cost per dozen shovel blanks heated with oil of 5 cents; heated with best Lehigh coal, 12½ cents. The oil cost 4¼ cents per gall. and the coal $6 per ton.

Further information regarding the various applications of the system may be obtained from the company or from its local agents in the principal cities. Mr. W. S. COLLINS, 171 Broadway, is agent for New York and vicinity. Wm. Pickett, Son & Co. are the agents for Chicago.

County Roads in New Jersey.

Property owners in Union County, N. J., says the *New York Times*, are delighted with the outcome of the County Road Bill, the object and purpose of which is the acquirement, improving, and maintenance of public roads in that State as lately given in full in this journal. Speaking of the benefits accruing therefrom, Mr. CHAUNCEY B. RIPLEY one of the largest tax-payers in Westfield, said lately:

The County Road Act provides that any public road in any county of the State may be declared a county road by the County Board of Chosen Freeholders in that county, and becomes such by the filing of a map with the Clerk of the county defining the road; and that money may be raised by such board for the construction and care of all such roads in any county. Union County is entitled to the credit of this new system. The act was prepared and presented by its citizens, who have for several years deemed some such road law a necessity for the permanent improvement of the public roads in Central New Jersey.

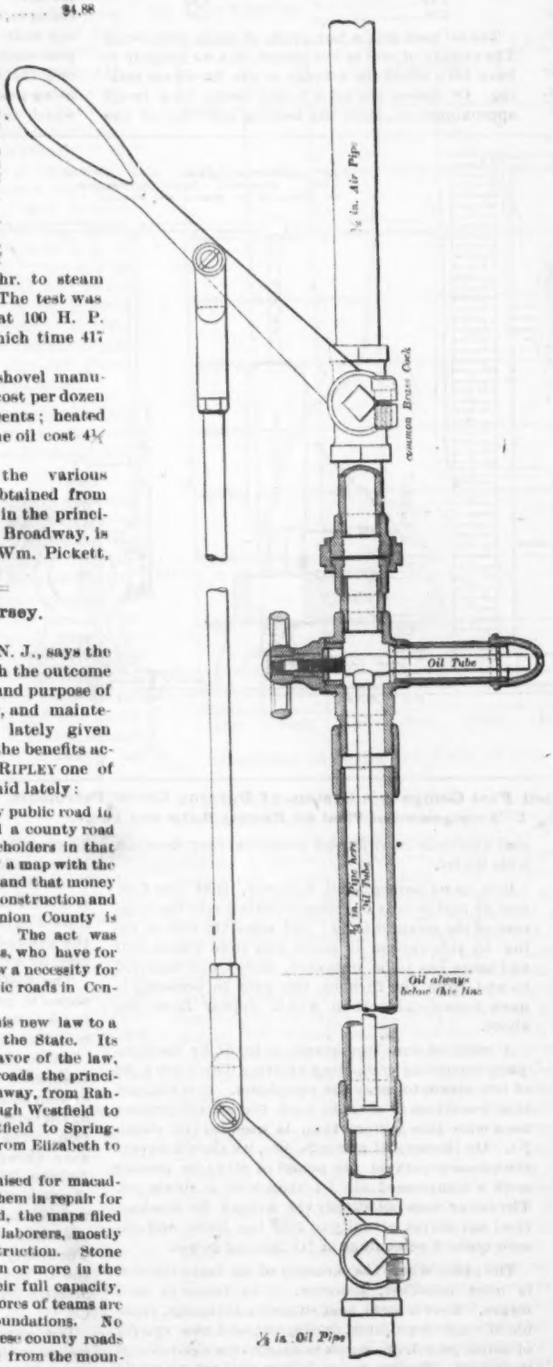
Union County has availed itself of this new law to a greater extent than any other county in the State. Its Board of Freeholders, unanimous in favor of the law, proceeded at once to declare as county roads the principal roads leading from Elizabeth to Rahway, from Rahway to Westfield, from Elizabeth through Westfield to Plainfield, from Plainfield through Westfield to Springfield, from Springfield to Summit, and from Elizabeth to Springfield.

The sum of $150,000 has already been raised for macadamizing these roads and for keeping them in repair for one year. They have all been surveyed, the maps filed with the County Clerk, and hundreds of laborers, mostly Italians, are now engaged in their construction. Stone crushers, of which there are half a dozen or more in the county of Union, are running to their full capacity, cracking stone for top dressing, while scores of teams are hauling stone in blocks for the solid foundations. No stone is used in the construction of these county roads except trap rock, which is all quarried from the mountains in Westfield. This rock abounds in these mountains and the supply is inexhaustible.

The whole appearance of the localities where these roads are being constructed is changed for the better. Before any stone is used, the bed of the road is to be macadamized, is brought to a grade, the high points being cut down, and the low places being filled with the earth taken from high points.

The new county roads are very popular. Those few who feared the expense at first are now more than satisfied with the improvements as they progress; and it is safe to say that there is not a taxpayer in the county that would have the new law repealed, or the old condition of things restored, to save the small expense incurred. County roads under the new law will soon become general in most of the counties in the State, especially if built with the economy, care, and thoroughness which characterize the present Board of Chosen Freeholders in Union County. We want more county roads next year, and the present board to construct them or a board equally good.

The work is being honestly done, and there are no political jobs, as some feared. These county roads have been advocated for several years by the largest property owners and taxpayers in Westfield, and they are well satisfied with the operation of the new law.



The Aerated Fuel Company's System of Burning Crude Petroleum.

Fig. 2. Cross-Section of Burner.

The New Bear Valley Dam.

(Concluded from Page 486.)

We continue from last week our description of this new work, with the accompanying drawings of the outlet pipe arrangements, and the following abstract of the report of the designing engineer, Mr. JAS. S. BLACK, on the question of waste weir and outlet pipes. To enable the report to be readily followed, we repeat from last week that the present dam, which stores some 50 ft. of water, is to be raised to store 80 ft. at first, but is planned to be still further enlarged at any time to the extreme height of 120 ft. Mr. BLACK says in substance:

I shall consider the question of waste weir only in connection with the 80 ft. dam, leaving the one for the 120 ft. dam to be designed when the final extension is made, as you will then have some additional years' experience, with this watershed as a guide to the proper solution of the question.

The outlet pipes should of course be designed of sufficient capacity to accommodate the flow after the 120 ft. dam has been built.

In attempting to arrive at the required capacity, I have been guided by the following considerations.

When the lake is raised above the 80 ft. level, it will have a drainage area of about 95 sq. miles, besides some 50 to 75 sq. miles that may be turned in by artificial means.

As this basin was evidently occupied by a lake in remote ages, before the rocky barrier at the western end was broken, it seems probable that the sides and bottom will be of an impervious nature, and if so, at least one-half of the rainfall on the whole drainage area should find its way into the lake, leaving the other half for seepage and evaporation.

If an average annual rainfall of 24 ins. can be secured and stored for the 95 sq. miles of drainage, then the reservoir may be called upon for a flow of 30,000 miners' inches for 100 days for every year.

Starting the 100 days with the lake full to the 120 ft. level, this flow of 30,000 miners' inches will use less than a quarter of the water in the reservoir, and leave about 1,250,000 cu. ft. of water above the 100 ft. level.

This, with merely increment enough to supply the loss by seepage and evaporation, would carry the country over four dry years, and yield 30,000 miners' inches for 100 days each year, and still have some to spare.

In view of this and of the possibility of turning in at least 50 miles more of the best drainage area in the San Bernardino Mountains, it seems entirely reasonable to expect that the reservoir will have a working capacity, eventually at least, equal to 30,000 miners' inches for 100 days each year.

It is probable that during the height of the irrigating season the maximum daily demand will be at least twice the average daily demand for the entire season, or 60,000 miners' inches.

One pipe 36 ins. in diameter under 80 ft. head will discharge 20,500 miners' inches, and under 120 ft. head the same pipe will discharge about 25,000 miners' inches.

As two of these pipes will hardly equal the estimated maximum demand, and as one may at times be laid up for repairs, and as these pipes will greatly assist in controlling the surplus water in time of a flood, I recommend that three 36-in. pipes be employed for the outlet, and that they be laid on parallel lines through the masonry; and as a given pipe will have a greater capacity in proportion as its depth increases, I recommend that they all be laid at or near the bottom of the dam as shown on the drawings.

As the gates which control the flow through these pipes will at times need repairs, and as they must at such times be relieved of pressure without drawing the water off from the reservoir, I have provided an inside gate tower or well, into which the inner ends of the pipes will enter and where the gates will be located. This well will receive its supply through openings at different elevations; and when repair or inspection is necessary, these openings will be closed with plain covers and the well drained, when the pipes may be entered and inspected, and the working parts of the gates removed for repairs if necessary.

The covers will be supplied with small auxiliary valves, which may be opened, first allowing the well to fill slowly, after which the covers may be easily removed.

The well should be of such size that the water may enter and leave it quietly and without turbulence when running at full capacity.

With a well of 18 ft. internal diameter, the downward velocity of the water, when the outlet pipes are wide open, will be about 5.9 ft. per second. As this velocity is as great as seems consistent with the requirements, I have considered 18 ft. as a desirable inside diameter for the well.

The combined area of the inlets should be much in excess of the outlets, in order that they may supply the water as needed without too great a reduction of head in the well.

I recommend that the outlet pipes be of cast-iron of 36 ins. internal diameter and 1¼ in. thickness, with a collar 1½ in. thick and projecting 3 ins. cast midway on each length and the lengths put together with bell and spigot and calked with lead in the usual manner. This thickness of 1¼ in. would give the pipes a safety of nearly 20 against bursting with the full hydrostatic head of 120 ft. and a safety against collapsing by the pressure of the masonry when the pipes were empty of about 17. I have supposed this thickness to be necessary to resist rupture from deflection caused by the unequal settling of the masonry.

The question of location and capacity of the waste weir is a very important one, and at the same time one that does not admit of a rigorous and definite solution.

The records of rainfall for this drainage do not extend back to any period of maximum precipitation and therefore the question must be settled chiefly by determining as near as may be the probabilities by comparing with similar drainage areas elsewhere and by observing the flood-mar'ks left along the channel of the stream, and such other evidence as is obtainable.

A rainfall of 7 ins. in 24 hours is not of very rare occurrence on the Atlantic coast, or farther north on this coast, and probably occurs at times in the mountain regions of this country. If we assume such a rainfall as occurring in Bear Valley at a time when the ground was frozen and covered with snow, which by melting would make 2 ins. more of water, we will probably have data sufficiently near the true maximum for present purposes.

According to the best authorities I can find, the actual flow from such an area as this may equal two-thirds of the total fall in a given time.

Two-thirds of the assumed 9 ins. of water will give a flow of 8,050 miners' inches from each square mile of the drainage area.

When just past the 80 ft. level the lake will have a combined area in both basins of 8.73 square miles.

The water in the lake may be permitted to rise temporarily 2 ft. high against the wave parapet with entire safety, and this 2 ft. in depth over the area of the lake will accommodate the estimated flow from 35 square miles of the drainage, leaving 60 square miles still to be provided for by the outlet pipes and waste weir. The flow from these 60 square miles according to the above estimates will amount to 483,000 miners' inches. As the pipes above specified for outlets will accommodate only about 61,500 miners' inches, the waste must be capable of handling the balance, or 421,500 miners' inches. This will require about 170 ft. of weir crest running 6 ft. deep.

I therefore recommend, if the 80 ft. dam be built corresponding in cross section to the upper 80 ft. of the 120 ft. dam, that it be provided with waste weirs at either end which shall aggregate in length at least 170 ft. and that these weirs be provided with sluice gates that shall when closed be level with the crest of the dam at the foot of the wave parapet and be capable of being opened so as to give a free passage to a depth of 4 ft. below that level.

If the lower 80 ft. of the 120 ft. dam be carried up of its entire thickness at once, which I strongly recommend, then the length of the waste weir may be greatly reduced as the water may pass over the entire crest of the dam in an emergency with safety.

This estimated volume of flow would at first thought seem too large, but on further consideration you will find that it is small, and the reason for making it small is that in an emergency the water may safely rise higher in the lake, thus greatly increasing the flow over the weir and diminishing the flood by holding more of the water in storage.

In support of the assertion that the estimated flow is small for a flood year, I submit the following facts.

Mr. J. T. FANNING, in a table for required lengths of waste weirs (see Treatise on Hydraulics p. 381), gives a length of 212 ft. as due to a drainage area of square miles, with the explanation that this is for "average American Atlantic slopes with mean annual rainfalls of 40 to 50 ins."

Average Atlantic slopes are usually of less inclination and are underlaid by pervious soils which act as reservoirs, thus to a considerable extent equalizing the flow of the streams, the proof of which is found in the fact that such streams usually keep up their flow fairly well in dry seasons.

The reverse of all this is the case at Bear Valley. The slopes are mostly very steep and the basin mainly impervious and having comparatively little storage capacity beneath the surface, as is proven by the fact that before the present dam was built the stream would carry off nearly the entire rainfall in the flush months, leaving the channel practically dry in summer.

Nov. 15, 1883, there was less than 2½ miners' ins. flowing out of the valley; four months later "the valley looked like a river."

Feb. 2, the same year, eighty days after the valley was dry, water was running over the top of the foundation of the present dam in a stream 60 ft. wide and too deep for a man to cross, and it appears that there was a channel 6 ft. wide and 3 ft. deep which had to be filled before the water could rise to the top of the foundation.

Between the dates given, Nov. 15 and Feb. 2, there had been but 17.3 ins. water fall from both rain and snow, and even of that a large portion remained on the ground in the shape of saturated snow.

As the observed rainfall in Bear Valley has averaged about 53 ins. per annum for the last six years, this drainage will exceed in this respect also those upon which Mr. FANNING'S calculations are based.

As evidence that the assumed precipitation of 7 ins. of rain in 24 hours is possible in Bear Valley, I submit the following facts, gathered from the Bear Valley record books:

Feb. 1, 1884, 5 ins. of rain fell at the dam. March 5 of the same year, 5.15 ins. Dec. 21, 1885, 6 ins. of rain fell, and during this storm 2 ins. fell in three hours. Jan. 19, 1886, 2 ins. of rain fell in one hour, and March 13, 1889, 6 ins. of rain and 2½ ins. of snow fell.

As evidence that with the assumed rainfall of 7 ins., and under the assumed conditions, that is, ground frozen and covered with snow, the maximum flow may surpass what the foregoing computation provides for, I call your attention to the fact that during the late flood in Pennsylvania, before the South Fork dam gave way, the reservoir behind it was receiving and discharging upwards of 500,000 miners' inches of water from a drainage area of less than 50 sq. miles, with no cloud-burst or water-spout, but simply from a heavy rain, and the ground was neither frozen nor covered with snow.

The estimated flow of 8,050 miners' inches from each square mile would, for the 55 square miles of drainage of the lower basin, equal the volume of a stream 175 ft. wide, 5 ft. deep, and flowing about 10 ft. per second; and an examination of high-water marks left by former floods in Bear Creek Cañon would seem to remove all doubt that this amount of water has at times actually passed through the channel.

As the waste weir acts as the safety valve of the reservoir, this question is of vital importance, and I therefore recommend the above facts and figures for your careful consideration.

The specifications to govern the construction of the new Bear Valley Dam are as follows:

Foundation.—The foundation shall be thoroughly cleaned for some distance above and below the location of the dam and shall be excavated till a firm and compact rock is reached. If seams are encountered, they must be cut out and filled up to the entire satisfaction of the engineer, and in no case must the bed rock be covered till it has passed under the inspection of the engineer and been approved by him. The foundation shall be stepped in inclines approximately as shown on the drawings and described for the outer courses of masonry.

Masonry.—None but the best gray rock shall be used in construction.—The outer face of the 120 ft. dam shall consist of hammer-dressed ashlar masonry, a header and stretcher alternating throughout the entire face and laid with as close joints as practicable. The outer face of each stone shall have a tool draught not less than 1½ ins., wide all around and be dressed true and accurately to form and dimension given by the engineer; the balance of the face of each stone may be left rough, but with no projection of more than 3 ins.

Both beds and joints to be hammer-dressed for a distance back from the face of not less than 1½ times the height of the stone. No stone to be less than 16 ins. in height. No stone to have a length greater than five times the height, nor less than two times the height, nor a breadth greater than 3 times or less than 1½ times the height; and no bond in any case to be less than 16 ins.

The tops of all the steps shall be coped with large stones nicely dressed and laid with joints not more than ¼ in. in width; they shall have a projection of 4 ins. over the face and shall extend into the body of the dam not less than 16 ins. They shall have a uniform depth of 18 ins. and be put together with cast-iron dowels 2 in. in diameter with swelled heads and bedded in sulphur; they shall be cut to the form given by the engineer and fitted into place dry, after which they shall be removed and a full bed of mortar of two parts sharp sand and one part Portland cement prepared for their reception. The coping stone must be clean and sound, of hard gray rock free from spawls or scales, and must ring under the hammer. No coping stones must be less than 3 ft. in width, and each stone shall cover the entire width of the step.

The inner back next the water shall be of the same workmanship and finish as the outer face except as to coping, and shall be laid in freshly mixed mortar of two parts sharp sand and one part good Portland cement for a depth of 2 ft. from the face. The joints of all exposed surfaces shall be cleaned off for a depth of 3 ins. from the face and pointed with strong cement mortar to be prescribed by the engineer, and well rammed to place. The interior of the structure shall consist of first-class rubble masonry. The stones shall be of the best form obtainable from the quarries and all thin parts broken off with the hammer before placing in position. No stone in any part of the dam shall be dressed with the hammer after being placed in position unless by special consent of the engineer. If the bond of any stone becomes broken after setting, it shall in all cases be removed and reset before being covered. No stone shall be laid, the upper face of which forms an angle with the plane of its bed greater than 30°, or the side joint of which forms an angle with the same plane less than 60°.

In the body of the dam all the stones shall conform approximately to the form prescribed for the facing stones, but more latitude will be allowed as to thickness, provided the relative proportion of length and breadth to thickness are maintained. Each stone shall be laid on its natural bed on a full bed of mortar, and each stone must lie solid on its bed.

All spawls, cement, and rubbish of all kinds must be thoroughly cleaned away where each stone is to lay, and a bed prepared in the best possible manner before the stone is placed in its proper position. Each stone shall be set approximately 3 ins. from its neighbors, and the intervening spaces filled with concrete composed of clean broken stone, the largest pieces of which shall pass through a 2-in. ring, screened gravel and cement mortar in proportions to be prescribed by the engineer, and thoroughly rammed with an iron rammer till the water stands on top.

No coursing will be permitted in any part of the work, but a thorough bonding in all directions, both horizontal and vertical, must be preserved throughout the entire structure, the bonding or overlapping to be 9 ins. as a minimum.

The beds of the stones in the outer one-third of the dam will be inclined in a direction approaching a plane normal to the direction of the resultant of the weight of masonry and water pressure, gradually changing to a horizontal as the center of the mass is approached. The extent of this inclination will be given by the engineer as the work advances. All inferior and defective stones will be rejected.

Cement.—Nothing but good Portland cement will be used in construction, and it must fulfill the following requirements, viz.: Samples to be mixed to a stiff paste and pressed with a moderate pressure with the fingers into moulds. As soon as the cement is well set, say one hour, it will be removed from the moulds and placed in water for seven days. Each sample must then resist a compressive strain of 1,800 lbs. per sq. in., and a tensile strain of 250 lbs. per sq. in. Beams 1 in. square and 12 ins. clear span must stand a load of 30 lbs. on the center, the test to be made as soon as removed from the water.

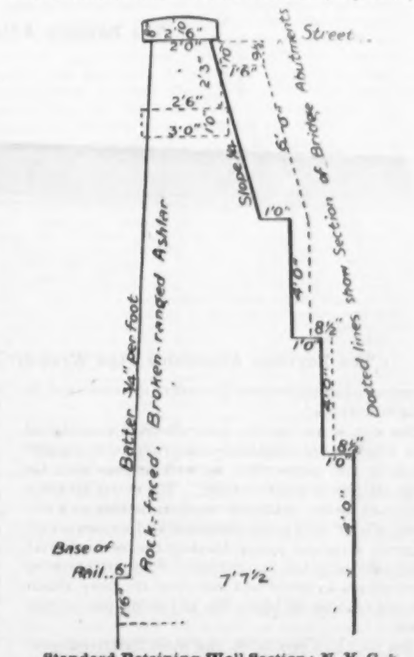
The engineer shall have the right to test each barrel if he choose, and reject all that does not meet the above requirements. Any rejected cement must be immediately removed from the grounds. The test shall be made at the station where unloaded, before hauling to the works.

Concrete.—The concrete shall be composed of broken stone, screened gravel and cement mortar mixed in such proportions as the engineer shall direct, and both mortar and concrete shall be freshly mixed in a machine made for the purpose and used immediately after mixing. No grouting will be permitted unless by special consent and under the directions of the engineer. The work is to conform to the drawings submitted and to such other as shall be furnished from time to time.

JAMES S. BLACK,
Designing Engineer.

Standard Retaining Wall Section, New York Central & Hudson River Railroad.

On the new Harlem improvement of the New York Central & Hudson River Railroad, depressing



Standard Retaining Wall Section; N. Y. C. & H. R. R. R. WALTER KATTE, Chief Engineer.

the tracks through the "annexed district" north of the Harlem River, as far as to the Mount Vernon Junction of the New York, New Haven & Hartford Railroad, there is an immense amount of retaining wall, all of which is built to stand forever, of a very excellent quality of rock-faced broken range ashlar. The accompanying cut shows the standard section which has been adopted, in a wall 18 ft. high between base of rail and under side of coping. It is 7 ft. 7½ ins. thick at the base, or a shade more than 0.42 of the height under coping.

This is substantially the same cross-section that was used on the sunken tracks south of the Harlem River, which stand absolutely uninjured by frost or anything else after some fifteen years or so of service. The wall therefore seems to be amply thick enough for this quality of masonry and kind of soil, although, with poor masonry, very severe frosts, or wet, clayey material, it might prove inadequate.

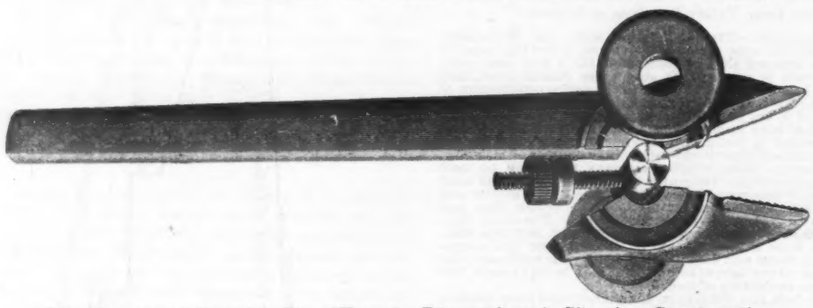
UNION DEPOT SCHEMES are being agitated at Burlington, Vt., and Raleigh, N. C.

An Improved Pipe-Wrench.

We illustrate, in the two cuts herewith presented, a novel wrench for the rotation of any cylindrical body within its range, its ordinary use being for the manipulation of piping, studs, etc. It will be seen to embody several very valuable features not heretofore obtained in wrenches of this kind. It is particularly adapted to operation upon close coils and in corners. The opening between the jaws is adjustable by means of the nut, so that for any of the larger sizes within its range, the pipe may always be grasped by the extreme ends of the jaws, and thus enable the user to rotate a pipe or stud in many close situations which cannot be reached by any other wrench on the market.

The wrench operates on the principle that, in rotating it on pipe of any size within its capacity, it slides up the smooth jaw until the serrated jaw bites into it sufficiently to rotate it, and the adjustment of the opening requires only to be made such that at this point the pipe shall impinge against the stop in the smooth jaw, to prevent further entrance into the opening and thus avoid crushing in the case of thin-walled pipe. The stop also furnishes means of giving the wrench a greater range in the direction of smaller sizes for ordinary work not in close situations.

The Boynton Adjustable Pipe Wrench.



The Boynton Adjustable Pipe Wrench; Dismembered, Showing Construction.

The cut showing the instrument dismembered will disclose its admirable construction as regards strength and proportion, as well as provision for great facility in manufacture. The entire strain is sustained by the rabbeted washers acting as a fulcrum axis of very large diameter and consequently of great resisting power, leaving the central rivet to sustain only the insignificant duty of retaining the washers in place and resisting the very slight stresses tending to move the adjusting-nut on the screw.

This tool has met with the most flattering success since its introduction, and fills a place among pipe-wrenches hitherto vacant. It is the invention of Mr. E. S. BOYNTON, and is manufactured and sold by the Campbell Printing Press & Manufacturing Co., 160 William St., New York, and 325 Dearborn St., Chicago.

ANOTHER LEARY RAFT is to be sent from St. John, N. B., this winter. As proposed it will be 750 ft. long and 45 ft. wide and deep, drawing about 25 ft. of water. It is to contain from 27,000 to 28,600 sticks, entirely of piles and spar-timber. It is intended to launch it next May.

PUBLICATIONS RECEIVED.

—*Steam Boilers. Abendroth & Root Manufacturing Co., N. Y.*

While modestly issued as a trade publication by the above company, this is rather a technical and very complete description of one of the best types of sectional boilers anywhere in use, with most excellent illustrations of its various parts, with the purpose and arrangement in practice and general advantages fully set forth. Instead of loading down this publication with testimonials, the engineer of the company, Mr E. M. HUGHSTOBLER, M. E., has given very considerable matter useful to users of any type of boiler or engine. First in this list is an empirical formula, and a diagram deduced from it, for chimney area, which is elsewhere given in full. Then follows a table of horse-power conversions, ranging by short intervals from 0 to 300 lbs. steam pressure by gauge, and from 32° to 212° Fahr. temperature of feed water, the latter varying by single degrees. In this table the standard of boiler horse-power as adopted by the American Society of Mechanical Engineers is taken as a basis, with an assumed average barometric pressure of 14.70 lbs. In this table, by simple inspection, the user is enabled to rate his own or any other boiler, with regard not only to its ultimate capacity but also in relation to its full consumption and evaporative efficiency, the only honest basis of comparison of horse-power.

The concluding table is one of relative factors of evaporation. The range of this table is the same as of that preceding it, and is based upon a like assumed average barometric pressure of 14.70 lbs. The table furnishes ready means of ascertaining the equivalent in pounds of water evaporated from and at 212° Fahr. of the observed evaporation of a boiler at any given pressure and any given temperature of feed water. The same table likewise affords a basis for comparing the relative cost of making steam under varying conditions. Both of these tables, while based upon simple and well-known rules, save the steam user an immense amount of personal labor, and bring these rules down to what may be called a commercial basis. We believe they have never been before presented in this very practical and handy shape, and the computor is well deserving of the thanks of engineers for the labor he has expended upon them. The book itself is very artistically illustrated, both in the views given of the sectional boiler and its parts and in the appropriate and especially designed chapter "head-pieces." A sectional plan of the building of the Philadelphia Edison Electric Light Company's station is especially interesting, as showing the concentration of 10,000 horse-power in a building which only measures 98 x 69 ft. inside the walls, these boilers all being of the Abendroth & Root type.

SOCIETY PROCEEDINGS.

The Boston Society of Civil Engineers held their monthly meeting on Nov. 20 at the American House. During the afternoon the members made an excursion to the Beacon St. tunnel of the Sudbury River aqueduct to inspect the methods used in lining the tunnel with concrete, this being made necessary by the disintegration and falling of the rock and roof. In the evening about 61 gentlemen, including a number of guests, listened to the reading by Mr. MORAN of a paper by Mr. E. L. ABBOT of the Poetsch-Scoysmith Freezing Company, on the subject "The Freezing Process of Making Excavations in Wet Ground."

New York Railroad Club.—At the meeting of Nov. 21 the subject of steel-tired wheels, which was to have been discussed, was postponed, on account of the absence of Mr. H. M. BOIES, who was to have presented a paper on the subject.

A committee was appointed to prepare appropriate resolutions regarding the late D. A. HOPKINS.

The election of officers to serve for the ensuing year then took place, and the following were chosen:

President, ROSS KELLS, Supt. Motive Power N. Y., L. E. & W.

1st *Vice-President*, R. C. BLACKALL, Supt. Motive Power D. & H. Canal Co.

2d *Vice-President*, W. L. HOFFECKER, Supt. Motive Power C. R. R. of N. J.

Secretary, LEWIS R. POMEROY, Sec. & Treas. Suburban R. T. Ry.

Treasurer, C. A. SMITH, National Tank Line.

Executive Committee: H. TANDY, N. Y., Ont. & W.; H. A. WEBSTER, Manhattan Elev.; J. W. BAKER, Del., Lack. & W.; THOS. MELLEN, N. Y. Cy & No'n; THOS. ALCORN, West Shore; E. B. WETMORE Sub. R. T.; W. H. LEWIS, Del., Lack. & W.; W. C. ENNIS, N. Y., Susq. & W.; H. S. HAYWOOD, Pa.

By a rising vote, thanks were expressed to Secretary C. A. SMITH and President C. E. GAREY for their faithful and arduous labors in carrying on the work of the club in past years. Vice-President BLACKALL pledged himself to active work for the success of the club, and others of the newly chosen officers spoke in a similar way.

Brief remarks were made by Messrs. ALCORN, WEBSTER, COOLBAUGH, LEIGHTON, SMITH, GAREY, and others, in reference to the club in past years and its prospects for future success. Interesting facts brought out were, that the club was the first to be formed in the country. At one time the meetings were regularly attended by the men who have since taken an active part in forming the New England Railroad Club in Boston and the Western Railroad Club in Chicago. The present quarters have been open to railway men as a club room for the past sixteen years. The present M. C. B. axle was designed in the club rooms.

The opinion was freely expressed that at the present time a turning point had come in the club's existence, and that it was about to take a much more important position than it has hitherto held. The club was formerly known as the Master Car-Builders' Club, and the subjects of discussion were confined to car construction. Even since the change of name, the technical work has been almost wholly confined to subjects of this sort. It is now proposed to greatly extend the field of work, and discuss any and all subjects in connection with railway economy.

Several members expressed the opinion that in the near future it would be advisable to move the club's headquarters uptown, and secure more pleasant and commodious rooms. It was also generally agreed that none should hold office in the club who were not actively engaged in the railway service.

To give the new officers plenty of time to meet and make arrangements for the work of the club during the coming winter, it was voted to omit the December meeting of the club. An earnest appeal was made that all railway men residing near enough to New York to be able to attend the meetings of the club should join the club and take an active part in its discussions and work. Applications for membership should be made to the Secretary, LEWIS R. POMEROY, Suburban Rapid Transit Co., New York City.

The Engineering Association of the Southwest held its first annual meeting at Nashville, Tenn., on Nov. 21. The chief business was the election of officers for the ensuing year, as follows:

President, JOHN MCLEOD, Louisville, Ky.; First Vice-President, W. F. FOSTER, Nashville, Tenn.; Second Vice-President, EDWIN THACHER, Decatur, Ala.; Secretary, OLIN H. LANDRETH, Nashville, Tenn.; Treasurer, W. L. DUDLEY, Nashville, Tenn.; for Directors, from Tennessee, F. P. CLUTE, South Pittsburg, Tenn.; NILES MERIWETHER, Memphis, Tenn.; W. C. SMITH, Nashville, Tenn.; from other States, J. H. ADAMS, Birmingham, Ala.; A. V. GUDE, Atlanta, Ga.; WM. STARLING, Greenville, Miss.

Regular meetings will be held on the second Thursday of each month at Nashville, Tenn., and until permanent quarters are fitted up, the meetings will be held in the Y. M. C. A. building in that city.

Liverpool Engineering Society.—The fourth ordinary meeting of the sixteenth section of this society was held in the Royal Institution, Colquitt St., on Nov. 13, under the presidency of Mr HENRY N. WEST, M. Inst. C. E., etc., when a paper was read by Mr. GEORGE FARREN Assoc. M. Inst. C. E., entitled "The Stability of Earthwork and Masonry Dams." The paper dealt with the sources of the inherent weakness to which the failure of the Johnstown Dam in America was due, and embraced a description of dam designs in America, France, and Great Britain with a contrast of the main differences of each. The great dams of Furens and Pau, which had been examined by Mr. FARREN in connection with the preparation of his paper, were also described in detail, and compared with the Vyrnwy Dam. With great elaboration Mr. FARREN discussed, with the aid of diagrams, the construction of the latter in all its bearings. He abundantly demonstrated that, compared with other dams now in existence, and apparently quite safe at the present day, the safety of the Vyrnwy Dam, so far as it could be arrived at by calculation of known natural laws, is enormously in excess of these. The dam is not merely safe as regards its base but is theoretically and actually as safe throughout as human skill make it.

Western Railway Club—(*Concluded from page 489.*)—In answer to questions Mr. CASE said that he had not tried the plain steel shoe. In regard to the methods used in the experiments, a coach was run for several miles with a set of composite shoes and with a set of cast-iron shoes, the brake pressure on each truck being alike, and at various stops the temperature of the shoes and wheel were taken with a thermometer held by the hand on the shoe and wheel at the end of the stop.

By a recently designed machine, the brake shoe is run on a car wheel in the shop under similar conditions to those which obtain in service.

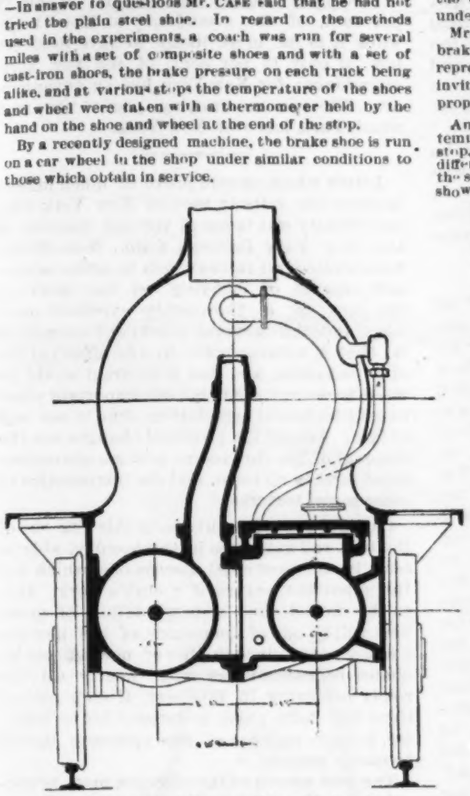


Fig. 1. Compound Locomotive with Inside Cylinders.

Mr. DRIGGS, of the Composite Metal Shoe Co., described an experiment with a shoe pressed against the wheel by a spring with apparatus for ascertaining the friction at different temperatures. After 2½ minutes run the temperature had risen two or three hundred degrees, and the shoe had worn about 9-1000 of an inch. After 2½ minutes more run the temperature had somewhat increased, and the shoe had worn three or four times as much as in the first 2½ minutes.

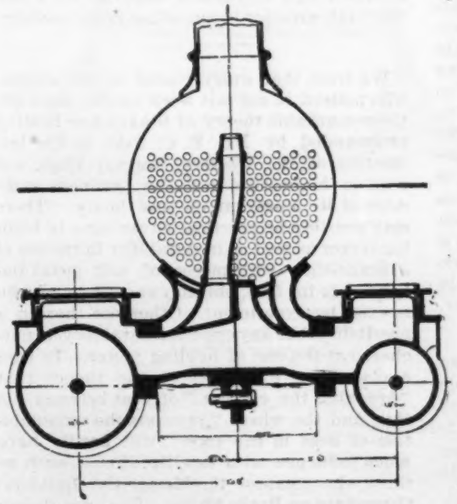


Fig. 2. Two-Cylinder Compound Engine, American Type.

Mr. SNOW.—We have always used a wrought-iron shoe up to two years ago, and had very good success. We tried cast-iron shoes, and also several others, but the wrought-iron shoe beats them every time. My experience is that a wrought-iron shoe will outwear about eight cast-iron shoes. The Congdon shoe comes up pretty close to the wrought-iron shoe, but it does not beat it. We use a cast-iron shoe on the steel-tired wheel. The different kinds of shoes have the same bearing surface. On suburban trains a wrought-iron shoe wears 15 to 30 days, while a cast-iron shoe will not last 3 days. With steel tires, however, there is a great deal of tire wear with wrought-iron shoes.

Mr. DRIGGS said the heat generated by friction under the wrought-iron shoe was much in excess of the heat under the cast-iron shoe.

Mr. RHODES said the M. C. B. Association Committee on brake shoes would hold a meeting on Dec. 18 to which representatives of all the brake shoe companies will be invited for the purpose of discussing what should be the proper tests for brake shoes.

An important point, of course, to be brought out, is the temperature of the shoe at different times during the stop, and also it is important to determine the friction at different periods during a stop. I am a little surprised at the statement in this paper that the tests that were made show that the friction of cast-iron shoes did not increase as the heating increased. I am in hopes that the representatives of the different shoe companies will all give the matter some attention between now and next month, by helping the committee with suggestions, and that we will be able to show the true value of the different shoes both in their capacity to retard trains and for wearing, and their values in dollars and cents.

Mr. CLEAVER said that a wrought shoe is very durable while the cast shoe is not, the relative life is about as a week to six months.

Mr. FORSYTHE.—I have been waiting for somebody to dispute the philosophy that has been offered here in explanation of the results obtained. The use of anti-friction metal to produce friction in a brake shoe is certainly a paradox, and the philosophy which is offered here to sustain that paradox is not sound. I do not believe that this soft metal is a practical thing for a brake shoe, and there are two simple reasons or objections to it. The one is that brake shoes when worn are blue, indicating a temperature above 900 degrees, and it shows that every brake shoe has attained that temperature; so that if this soft metal at a low melting point is used in brake shoes, it will be melted out before any great braking power is attained. Another result from the use of soft metal would be the accumulation of sand bedded in this soft metal, which would make the shoe act like a piece of sand paper, and wear the wheel away very rapidly. The results which have been reported here I do not consider of any value, because the fact of putting a bulb thermometer on a brake shoe in a current of air that is liable to be variable cannot give accurate results.

The reports on temperature are not of much value because they give a comparatively low temperature, and the very fact that that metal would melt out at a practical temperature obtained in railroad practice has prevented them from carrying the experiments far enough to obtain any information which is valuable on the high temperature.

Mr. DRIGGS.—We do not claim to prevent the generation of heat but to prevent the accumulation of it.

Mr. FORSYTHE.—I claim that the method of preventing that accumulation is not explained in this paper on sound principles. There is a theory there presented about counter-currents I have not seen, and I defy any one here to find it in any scientific book. The paper says that the philosophy teaches that; but this is a philosophy that is not contained in any of the text books.

The following paper was read by Mr. E. W. M. HUGHES, Chief Engineer of the Fox Solid Pressed Steel Co., and formerly Superintendent of Locomotives on the Northern State Railways of India, on the methods employed by him in converting ordinary locomotives to compound:

I have given much thought to the practical advisability of converting existing engines to the compound system.

If compounding is to be of any good to a railroad, it requires the converting of the whole stock of engines. The saving to be made in only a few new engines having the improved method would be but small to a road, and not of any appreciable value. I therefore consider that the most important points to be determined are: Can we at a small cost convert our ordinary high pressure engine into a compound, and in so doing make an actual gain that will justify the time and money laid out?

Early in 1882 I determined to make my experiments, but was prevented from personally supervising them owing to the extra duties thrown upon me in connection with the moving of troops into Afghanistan. The trials were, however, carried out to my plan on the lower sections of our road that were within the frontier limits of India.

Two old engines requiring heavy repairs were taken into the shops, and upon these the alterations were made. Both these engines required new cylinders. Each had 3 ft. 6 in. leading wheels with two pairs of 5 ft. wheels, coupled with 16 x 24 in. cylinders. In one of these engines the old 16 in. cylinders were replaced by an 18-in. high pressure and 24-in. low pressure as shown in Fig 1, these being as large as could conveniently be placed between the frames. The slide valve of the low pressure was worked direct as before, but that of the high pressure through the intervention of a rocking shaft. Excepting this slight modification, the gear remained the same as before. This arrangement gave excellent results in working. To meet any contingency of the high pressure cylinder sticking on a dead center, a valve was provided by which steam could be admitted direct from the boiler into the steam chest of the low pressure cylinders.

This engine was regularly employed on freight service and hauled 550 tons at the rate of 22 miles per hour, and consumed 13½ per cent. less fuel than an ordinary engine of its own class.

The other engine altered was of the same class. It was changed to a 4-cylinder compound, having a pair of outside high pressure cylinders of 11½ in. diameter and a pair of low pressure inside cylinders of 17 in. The original 24 in. stroke was retained for all four cylinders. The crank pins for the high pressure cylinders were fixed opposite to the cranks of the low pressure. The results obtained from this engine were identical with those from its sister engine above described. It was a better steaming engine than the two cylinder locomotive, but the latter was never short of steam.

The compounding of those two engines was a decided success. They were more powerful than in their original state, and showed a decided saving of 15½ per cent. in fuel. They were nothing new for the engineer to handle, and any engineer could drive them without special study.

Being old boilers the working pressure was only 120 lbs. per sq. in. With a higher pressure a much better economy would have been attained. The conclusions I have come to from the performance of these two engines are that it is quite possible to convert the ordinary high pressure engine into a compound at a reasonable cost with a decided advantage. I prefer two cylinders to four for the reason that it is far less complicated and less expensive. I consider it a mistake with three cylinder engines to leave off the coupling rods, as the wear from them, however little, will be more than counterbalanced by the unequal wear produced on wheels revolving at different speeds.

In Fig. 2, I show an outside cylinder engine (American type) with a pair of compound cylinders, and shall be glad to see some of our members take up the matter on these lines and give it an actual test. My experience shall be at his disposal, and I am confident the trial would result in economy to the company and a valuable experience to the profession generally.

I think much aid could be given to compounding by some suitable means of jacketing the cylinders. It is a difficult matter to steam-jacket a locomotive's cylinders, as they are carried so much below the water level of the boiler, thus making a proper drainage of the water from the jacket almost impossible. I do not see why a portion of the smoke-box gas could not be conveyed round the cylinders. I feel certain that a good system of jacketing the cylinders would lead to at least 8 to 10 per cent. higher economy in fuel.

In reply to questions from various members, Mr. HUGHES said that the cost of altering each engine was about $200, most of which was for pattern making. The record of 13½ per cent. saving in fuel was based on a service of 6,555 miles. The engines have been running since 1884, and a similar saving is still reported. Recently some English-built compound engines, Worsdell type, have been purchased for the road.

At first steam was carried directly from the high-pressure cylinder to the steam chest of the low-pressure cylinder; but that gave too small a reservoir for the steam, and the steam was very wet, so a 5-in. copper pipe was put inside the smoke box, and the steam was led through that in its passage to the low-pressure steam chest. This arrangement worked very well.

The compounding of an engine has no effect on its riding. One more plate was put in the leading spring. The compound engines have a much steadier draught than the simple engines. On the 2-cylinder engine the nozzle was decreased about ¼ in. On the 4-cylinder engine it was increased about ¾ in. With high pressure steam, 180 to 200 lbs., it is found in England that compound locomotives save about 15 per cent. On the Caledonian road they are trying the use of steam at similar pressures with ordinary locomotives, to see if a gain in economy will not result.

Mr. WM. FORSYTHE said: I believe thoroughly in the compound locomotive and I think the way for American engineers to start out to solve the problem is the way Mr. HUGHES started in India; that is to take the frame as it is and adapt it to the compound engine. I noticed the volume of the receiver in his first plan was very small, and was pleased to find that he afterwards used the proper pipe going around through the smoke-box. There is no doubt that is the correct principle, and there is a real advantage in getting dry steam and economy in fuel by its use. This subject is in its infancy here as we all know; but I believe that after we commence building compound locomotives, we shall all be surprised that we have waited so long to start. When in Manchester, England, this summer, I found that they were almost entirely engaged in making compound locomotives. At one place, Beyer, Peacock & Co's., they had under way, I think, 40 compound locomotives; most of these, however, were for the colonies and for distant foreign countries were used is expensive. In England the principle is gaining ground, although it is rather amusing and surprising to find roads under very intelligent management in the motive power departments differing so widely on this question. One of them was running compound engines successfully and showing a very appreciable improvement in economy, while another one seemed to have no belief in them whatever, and didn't think it worth while to take them up.

This, I think, is more a matter of personal feeling than of scientific facts, for I think every intelligent engineer who studies the question of the distribution and economy of steam in the locomotive will find that we have about reached the limit of maximum economy with the simple engine, where we use the steam once and then throw it away. One advantage which I think ought to be emphasized is the fact that we expect to get more power out of the locomotive at high speed. That is the weak point of the simple locomotive for passenger service. But with the compound engine you can get a very much larger opening of the exhaust nozzle, and the draught with the large exhaust nozzle reduces the back pressure, so that at a large cut-off you get a larger area of diagram at high speed than was possible with the simple engine. Another advantage is the more uniform pressure on the crank pin. The difference in the pressure each side of the piston in each cylinder is very much less than in the simple engine, and the consequence is that there is a more uniform stress throughout the machinery.

The Arkansas Society of Engineers, Architects, and Surveyors.—Held their third annual meeting at Little Rock, Ark., last week. A paper on the "Mines and Minerals of Pulaski and Saline Counties" was read before the Society by Mr. R. D'AILLY. Papers by Messrs. H. G. MARTIN on "The Rights, Duties and Responsibilities of Surveyors," E. C. BUCHANAN on miscellaneous subjects, and Prof. JAY M. WHITHAM, on "Hydraulic Rams." On Wednesday evening Dr. JOHN C. BRANNER delivered a lecture on "The Formation of Our Mountains, Hills, and Valleys."

The officers for the ensuing year are: W. P. HOMAN, President; FRED. J. H. RICKON, Corresponding Secretary; FRANK W. GIBB, Recording Secretary, and THEODORE HARTMAN, Treasurer; the first three forming the Board of Directors.

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we will be obliged if parties who fail to receive their papers promptly will notify us without delay.*

Coming Technical Meetings.

Engineers' Club of Kansas City, Mo.—Next meeting, Dec. 3. "Snow Plows." F. E. Sickels. Annual meeting, Dec. 4. Secy., Kenneth Allen, 200 Baird Building.

Western Society of Engineers, Chicago, Ill.—Next meeting, Dec. 4. Secy., J. W. Weston, 78 La Salle St.

American Society of Civil Engineers, New York.—Next meeting, Dec. 4. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Annual meeting, Dec. 4. Secy. W. H. Bryan, 809 So. 7th St.

Association of Civil Engineers, Dallas, Tex.—Next regular meeting, Dec. 6. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia, Pa.—Next meeting, Dec. 7. Secy., Howard Murphy, 1123 Girard St.

Civil Engineers' Club, Cleveland, O.—Next meeting, Dec. 9. Secy., C. O. Palmer, 21 Cedar Ave.

New England Railway Club, Boston, Mass.—Next meeting, Dec. 11. Rooms in the United States Hotel.

Civil Engineering Society (Inst. of Technology), Boston, Mass.—Next meeting, Dec. 12. Secy., Clement March.

Western Railway Club, Chicago, Ill.—Next meeting, Dec. 17. Rooms in the Phœnix Building.

Engineers' Society of Western Pennsylvania.—Next meeting, Dec. 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Dec. 18. "Ventilation of School Buildings," Wm. H. McClintock. Discussion on "Ventilation." Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, Jan. 16. Room at 113 Liberty St.

THE $5,000,000 guarantee for the New York World's Fair will probably have been all subscribed by the time this issue reaches our readers, and it greatly increases the chance that the Fair will be held in New York. That it will be held somewhere we may be quite sure, and that, wherever it is held, it will not be opened in the spring of 1892, seems to us almost equally sure, if proper care is to be used in preparing designs before the work of construction is proceeded with. Still, the facilities for such construction in this country are very great, and we may be reasonably confident that the organizing ability to push the work a little faster than such work has ever been pushed before (which is essential for the opening in 1892) likewise exists in this country, if it be only secured for the management. The trouble is, it may not be secured in advance, and whether or not it will be secured cannot be foretold, while haste is very likely to result in imperfectly studied or injudiciously selected designs. On the whole, wherever the Fair may be held, we are earnestly in favor of *beginning the reception of exhibits* on Oct. 12, 1892, the quadri-centennial of Columbus' discovery, and opening the Fair to the public as early as possible in 1893, thus giving an extra year for work. The "conclusion of the whole matter," which no one can well deny whatever view he is disposed to favor, is that it is a possible thing to open the Fair in creditable shape in 1892; but to make it certain from the beginning that it will be in creditable shape when opened, more time must be allowed.

THE thorough way in which statistics of all kind are collected in Paris makes the Exposition which has just closed particularly instructive, especially as an indication of how much weight should be attached to resident as distinguished from non-resident population, something which it is very difficult—in fact impossible—to determine from the records of our own Philadelphia Exposition. The only definite fact obtainable in regard to the latter is that out of nearly 10,000,000 admissions, 24 per cent. came by rail direct from exterior points and 35 per cent. more came by rail from the city. How many of the city visitors were temporary residents who were in Philadelphia only to attend the Exposition it would now be hard to determine even approximately. It is probable that somewhat less than two-thirds and certainly more than one-half of the visitors were from the 1,000,000 or so residents of Philadelphia and its vicinity and only the remaining one-third to one-half represented the rest of mankind. The Paris statistics make a still stronger case in favor of holding the exhibition in a city of the largest possible population if it is to be a financial success. The full official statistics are not yet at hand, but the unofficial ones reported by wire correspond with the partial official ones we have before us, and show that as a result of 24 million visits* there were 40½ million extra city trips (20 by Seine boats, 15 by omnibuses, 5½ by Ceinture Railway) and only 2½ million extra arrivals from the outside world by rail (39 against 31 million total railway passengers.) Each outside arrival would hardly average more than three visits, making 7½ million, or say 32 per cent., to be credited to outsiders, and 69 per cent. to be credited to the 2½ millions of Paris residents. At most each outside visitor would not make more than 5 visits, corresponding to just about 50 per cent. of attendance from outside, thus giving the same limits as we deduced from the Philadelphia statistics, besides which, it is to be remembered that there is but one Paris, and that the same Exposition would have far less drawing power in any other city.

TAKING the above two limits as making the best reasonable showing for the probable comparative attendance at an equally good fair held in Chicago and New York, we have:

	Chicago	*New York*
Approximate population	1,000,000	3,000,000
Assuming half of 30,000,000 attendance at New York to come from resident population, we have for the local visitors	5,000,000	15,000,000
And for the outside visitors, alike at both cities	15,000,000	15,000,000
Comparative total attendance	20,000,000	30,000,000
Assuming one-third only of a total attendance at New York of 30,000,000 to come from local residents, we have for the local visitors	3,333,333	10,000,000
And for the outside visitors, assumed alike for both cities	20,000,000	20,000,000
	23,333,333	30,000,000

The last is the most favorable possible showing for Chicago, and shows that it would at best have 6,667,000 less visitors, or only 77 per cent. of the attendance at New York, while it is far more likely to have 10,000,000 less, or only 67 per cent. of the New York attendance; for New York has an advantage over Chicago in drawing power like that which Paris has over New York.

*The official returns, since received, show 25,408,309 visitors.

ACTION which should prove of much importance to the railway men of New York City and vicinity was taken at the last meeting of the New York Railroad Club. New officers were elected, all railway men in active service and capable of carrying on the work of the club in a thoroughly excellent manner; and the general sentiment seemed to be that a turning-point in the affairs of the club had come, and that in future it would be made to occupy a much more important place among technical associations than it has held of late. Among the proposed changes are the removal of the club rooms to some convenient point farther up town, and the introduction of some social features.

Certainly, there should be in this city one of the best railway clubs in the country, able to lead in the technical discussions which are the important feature of a club's work. It is to be hoped that a large influx of members will be one of the results of the new departure; and since the list of new officers includes representatives from nearly all the roads centering in this city, if each one of these will take pains to interest his co-laborers, a large number of new members should be easily secured.

The past record of the club is a most honorable one; the field for useful work is wide. If the meetings can be made of sufficient interest and profit, it will be possible to secure the attendance of railway men from cities as far west as Pittsburg and as far east as Boston, as was done in the club's early days. But that is by no means necessary to secure a thorough success. The number of progressive railway men in New York and vicinity is great enough to furnish material for a railway club superior to any other in the country.

WE trust that every reader of this journal who noticed in our last week's issue, page 489, the remarkable theory of brake-shoe heating propounded by Mr. E. C. CASE at the last meeting of the Western Railway Club, will read in this week's issue the pertinent criticism of Mr. FORSYTHE on this theory. There may possibly be practical advantages in holding power as well as in durability in the use of a brake-shoe with pieces of soft metal imbedded in its face, but they should be proven to exist by experiment. Otherwise there is a possibility that any superior durability is purchased at the cost of holding power. To base a claim for excellence on the theory that "breaking the current" of heat between the shoe and the wheel "prevents the accumulation of heat in the shoe" will hardly have much influence with intelligent men, such as those who compose the Master Car Builders' Committee on Brake Shoes. The true theory of the matter is as simple as the one propounded by Mr. CASE was complex. The moving train contains a certain number of foot pounds of mechanical energy, and the office of the brake shoes is to stop the train by converting this mechanical energy into heat. Except for the small fraction of the energy absorbed in wearing away wheel and shoe, the whole energy of the moving train must be converted into heat, with a rapidity proportioned to the pressure on the shoe, before the train will stop. The representative of the Composite Metal Brake Shoe Company said

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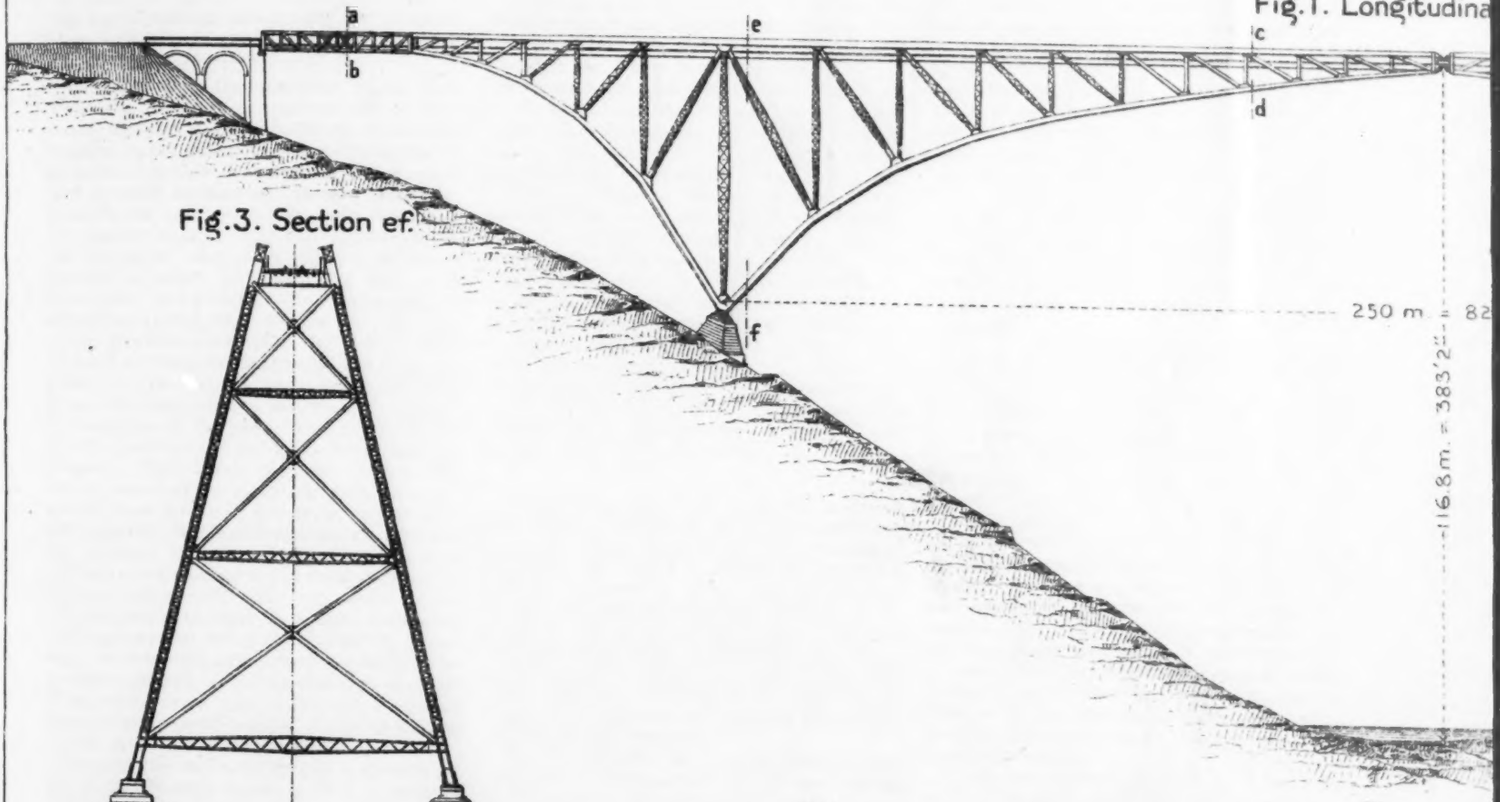
Fig. 1. Longitudina



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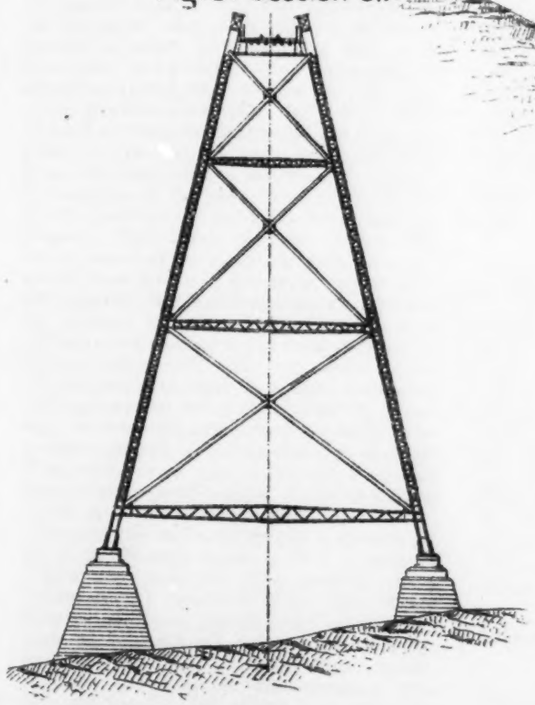

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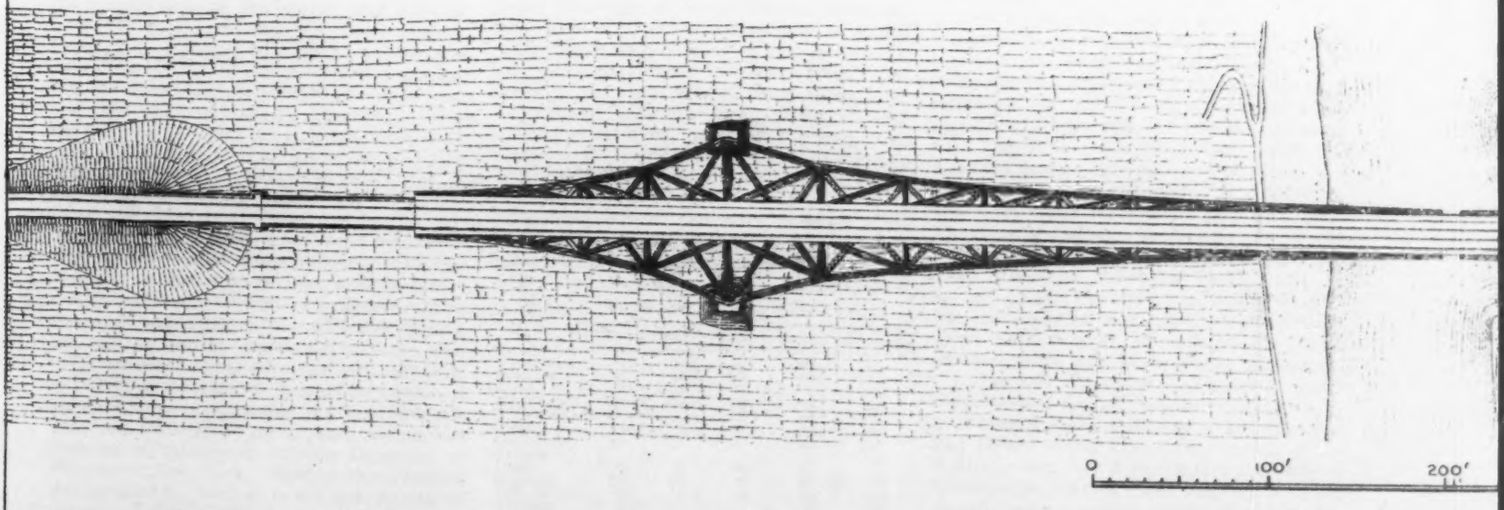

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SOCIÉTÉ DE CONSTRUCTION DES BATIGNOLLES, ENGINEERS AND BUILDERS.

Fig. 1. Longitudinal Elevation.

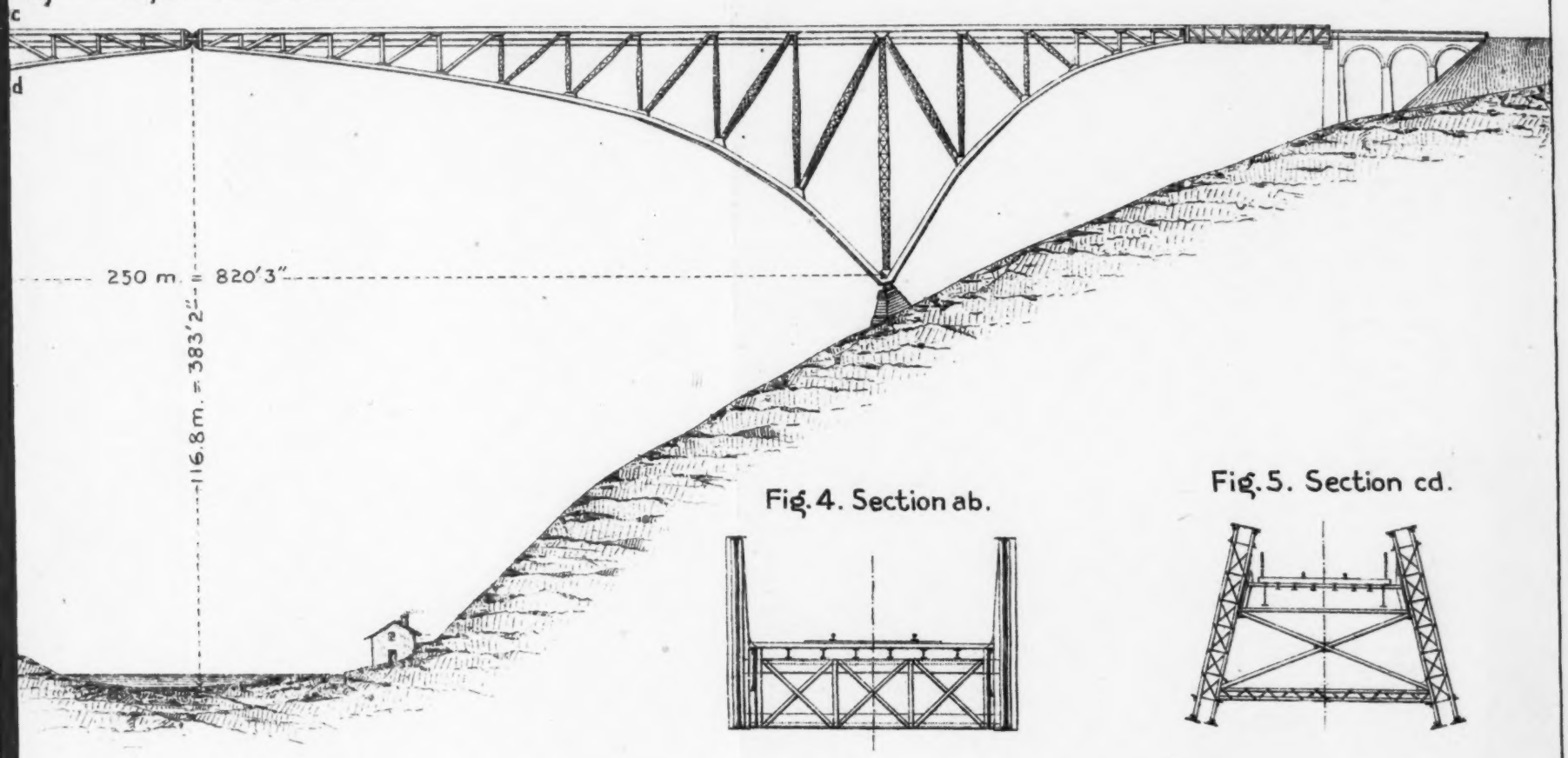
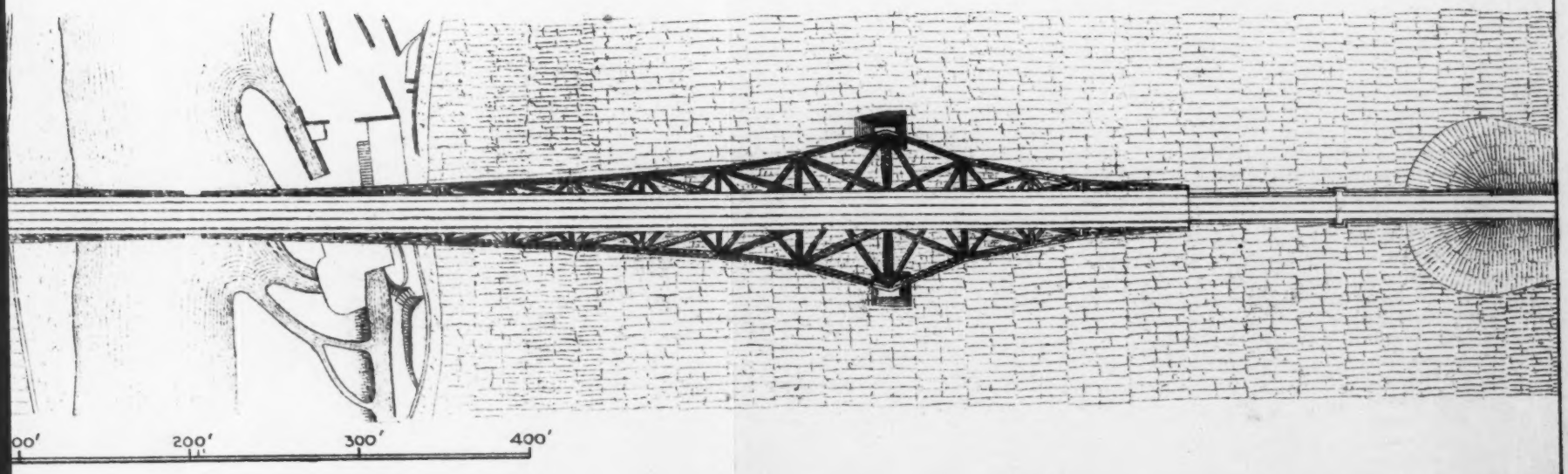


Fig. 4. Section ab.

Fig. 5. Section cd.

Fig. 2. Plan.



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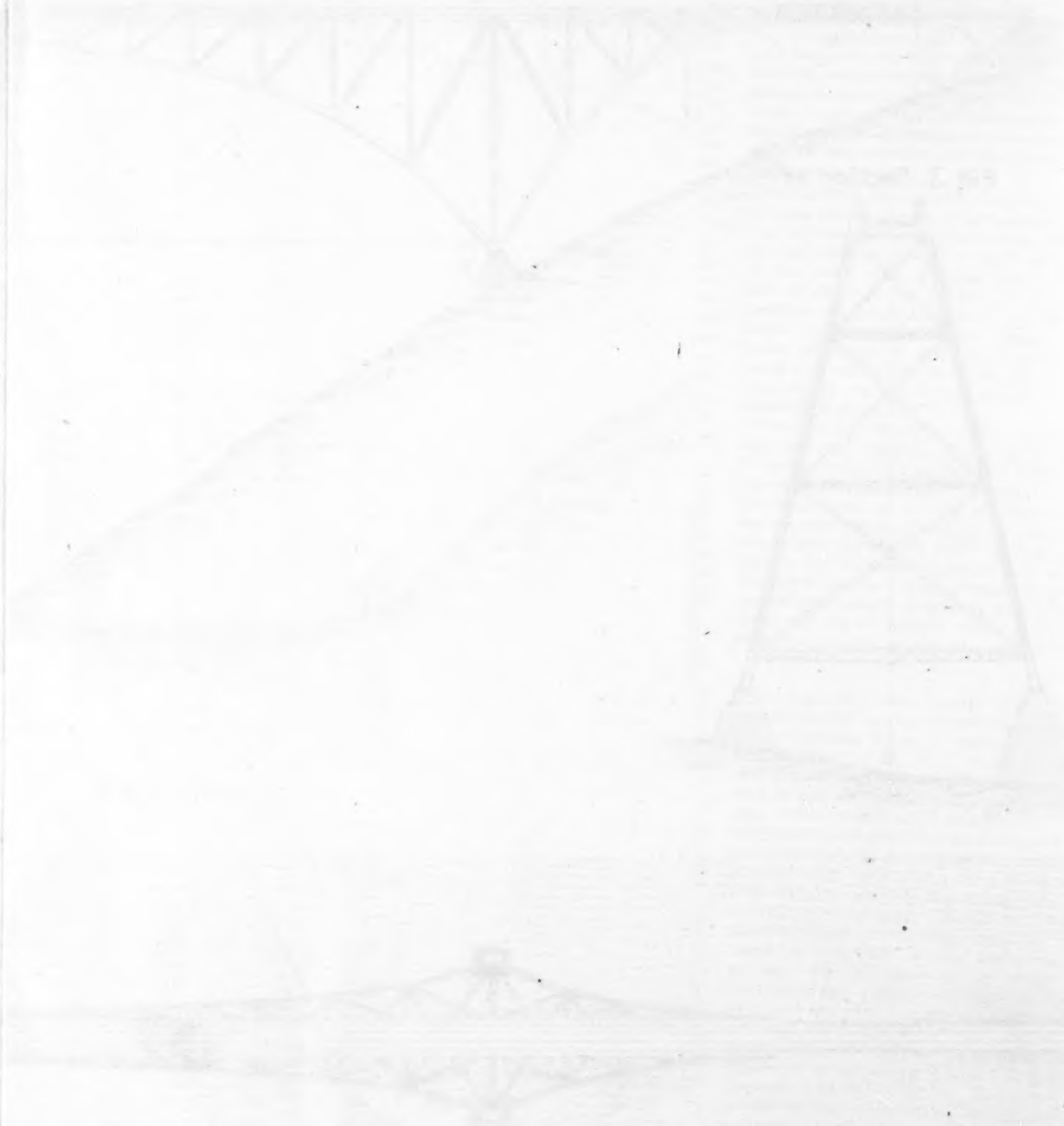


they only claimed to prevent the accumulation of this heat. But the only way to prevent the accumulation is to retard its formation by decreasing the friction, and also to transmit the heat to some other substance, as the surrounding air. It is just possible that the "non-conducting" shoe might help to transmit to the wheel a greater proportion of the heat generated, and so prevent the shoe becoming overheated; but Mr. CASE's specific claim for the composite shoe was that it prevented this transmission to the wheel. We must not be understood as condemning the Composite Metal shoe without a trial; but if it has equal holding power with the common shoe, it should get equally hot in a given time.

THE facts as to the new Bear Valley Dam which we present in our current and our last issue contain some significant details as bearing on the question of the proper design of dams, to which considerable of our space was devoted in the early part of last year. Bearing in mind that the new engineer, Mr. BLACK, is in no way responsible for the old structure, and is submitting to stockholders a report recommending that it be abandoned and a bigger dam constructed, his statement among other reasons for the proposed abandonment that there is a little leakage through the fissures of the rock and under the base of the dam, while yet there is no mention made of any sign of leakage or weakness in the dam itself, is significant of its excellent condition, as heretofore reported. The large estimate which Mr. BLACK makes of the added strength to be obtained from adopting a sharply curved plan for a gravity dam is also significant. We will not attempt to summarize, but simply refer all interested readers to it, noting only that it corresponds exactly with our views on the subject, and with what we believe will be the permanent judgment of the profession, except that it does not sufficiently emphasize the probable gain in durability as well as strength from having every part of the dam under all conditions in compression, which can never be the case with a straight gravity dam.

Finally, the most significant statement of all in Mr. BLACK's report is that, in making comparative estimates of a straight and a curved gravity dam, both of the same cross-section, he found that it took actually less material to build the curved dam than the straight one. The reason will be understood by any engineer who examines with care the ground plan shown last week: for the ground plan of the curved dam will be seen to be no larger than, if so large as, that needed for a straight dam, while it is thrown somewhat further up hill, so as to decrease the height. The plan also serves to illustrate the fact adduced by us in our first discussion,—that the practical question is not between a curved dam and a straight dam, but between a dam of straight face and curved toe, and a dam of curved face and straight toe.

INASMUCH as the need for rapid transit in New York becomes more pressing with the ever-increasing demands upon present facilities, Mayor GRANT doubtless intends to again push for legislation in this direction during the coming session of the Legislature. The objection made to his previous bill, sufficient as it was in its general features, was that it appeared as the production of himself and his personal counsellors alone, and not as the demand of prominent citizens generally of the city of New York. Party politics should not enter as an element in the acceptance or rejection of a measure of vital importance to the prosperity and growth of this city; but unfortunately it too often does so, and politics was doubtless the cause of the defeat of Mayor GRANT's bill last winter.

IT would seem to us, however, that this difficulty could be overcome in future proceedings not only by enlisting the sympathies of the people in this project,—for all now recognize the needs of the hour,—but by giving powerful expression to these sympathies by inviting a number of prominent citizens to confer with him, at an early date, on the general subject of drawing up and handling this transit bill. Even if a bill so evolved should be no better than the one already presented, the fact that it was the work of a non-political committee of representative citizens, acting with the Mayor in this matter, would go far towards concentrating public sentiment in its favor, and the bill itself would come before the Legislature shorn of its party thorns, and simply as a measure of public improvement of pressing need. The bill would then stand or fall according to its inherent merits or demerits, and it would introduce the subject in such a manner that it could be honestly amended, if necessary, and pushed to an issue. It is of vital importance to first secure legislative authority for fully investigating the conditions and possibilities of rapid transit in New York, and we cannot have this authority too soon. The manner of accomplishing the desired end is a later engineering question, which we trust that the wisdom of the Mayor and the people will properly provide for hereafter.

A CORRESPONDENT at the head of a railroad enterprise in the South writes us desiring to be put in communication with some person or firm who can place a sufficient amount of the company's bonds to secure rails and rolling stock. He reports that the road is to be about 80 miles in length, through a newly timbered but level country, and that local aid has been secured sufficient to grade and tie the road. The final location of the line is to be made, and contracts for grading will be let, in January or February next.

We will furnish our correspondent's name and address on request from any one desiring to investigate the enterprise and negotiate with its present backers.

Railway Construction in the Rocky Mountain and Pacific States.

The map of railway construction in the Rocky Mountain & Pacific States, which we publish with this issue of ENGINEERING NEWS, shows that a large mileage of new railways is now being constructed in the Far West, especially in the new States of Montana and Washington, and that the number of new railway enterprises not yet matured, but which seem to have some prospects of success, is larger probably now than ever before in this section.

The summary of the work recently completed, under way and projected in each of these States is given in the following table:

States	*Track laid*		*In Process of Construction*	*Located, or under Survey*	*Projects of some Promise*
	1888	1889			
Wyoming	24	50	87	445	225
Montana	117	99	136	400	340
Idaho	8	45	27	55	465
Washington	291	330	226	677	509
B. C.	.....	.....	40	100	85
Oregon	118	2	66	204	545
California	441	77	251	622	1267
Nevada	.....	.....	.....	175	210
Utah	35	16	140	375	15
Colorado	211	79	82	227	618
New Mexico	81	.....	40	250	210
Arizona	36	.....	4	50	484
Mexico	506	306	1315	240	1910
Total	1868	904	2414	3820	6883

The total, excluding Mexico, is

1362 698 1099 3580 4973

On March 31, 1888, when our last map of this section was published, the summary of work in the above States, excluding Mexico, was as follows:

Track laid		*In Process of construction*	*Located and under survey*	*Projects of some promise*
1888	1887			
809	2346	1266	4939	3196

A comparison of these two summaries would indicate that, taking the territory as a whole, about as much work is under way and in sight now as a year and a half ago. The relative location of the centers of active work, however, has changed, as becomes apparent on an inspection of the two maps. In the spring of 1888, California and Colorado were the States where work was most active. Now Washington and Montana seem to have the lead, although work in the two former States is by no means standing still.

A noticeable feature upon the present map is the number of very long lines which are projected or under survey, and are backed by responsible parties. A curious feature in reference to these lines is the fact that none seem to run east and west. Most of them pursue a general course from northeast to southwest.

One of the most widely advertised of these longer lines is seen in central Wyoming, extending from Ogden, Utah, to an eastern terminus at Sioux City, Ia., several hundred miles beyond the limit of our map. What interest is backing this enterprise has not yet appeared; indeed, it does not seem to be at all certain that the scheme has any stronger backing than that of a few professional speculators and boomers. Notwithstanding frequent assertions that the money to build the line was all secured, and that the whole road would be put under contract at once, work has not progressed thus far at any alarming rate. A hundred miles of easy work in Nebraska was put under contract six months ago; and, presumably from a lack of the sinews of war, not much besides this, so far as we are informed, has been done since.

There are several projects, one of which will probably reach success, for lines to run from some point on the Union Pacific north through central Wyoming to some point on the Northern Pacific near Billings, Montana. It is a fact not often realized that there is no railway connection between these two transcontinental lines for a distance of nearly 800 miles—from the Missouri River west to the Utah & Northern Railway in Idaho.

Most of the work in Montana is being carried on by the Northern Pacific. The St. Paul, Minneapolis & Manitoba Company, their only important competitor for this territory, is not doing much in the way of extensions at present. One of the most important lines to the Montana mining districts is the Northern Pacific cut-off from the main line direct to Butte, on which tracklaying is nearly completed. The detour via Helena, for traffic passing from the Butte district to the East over the Northern Pacific, will be avoided by this line; and coal from the mining regions lying just north of the Yellowstone Park will be brought to the Butte smelters much more cheaply than in the past.

A long and important line which is under consideration for next season's work is to extend from Billings northwest to Fort Benton, and thence to the mines and railway of the Northwestern Coal & Navigation Company at Leithbridge, Alberta. The southern half has already been surveyed by the Northern Pacific Company, and doubtless the whole line, if built, will be under its control.

The greatest center of activity on the map,

so far as the present year's work is concerned, seems to be Spokane Falls. An independent line, the Spokane Falls & Northern, is now finished north, nearly to the international boundary; The Oregon Railway & Navigation Co. has built in from the south; the Northern Pacific has completed its Central Washington branch west 87 miles; and the Seattle, Lake Shore & Eastern has 40 miles built on a road which closely parallels this line. A little farther south, the Oregon Railway & Navigation Co., has built this year a long extension into the Cœur d' Alene mining region and has now pushed its line nearly across northern Idaho. The Northern Pacific is also reaching out in the same locality, and it seems by our map that at an early day it intends to greatly shorten its present transcontinental line. The new route will leave the present new line a few miles west of Missoula, Mont., and is already under construction for a distance of thirty or forty miles. From this point surveys are being made onward to a connection with the railway purchased by the Northern Pacific a year ago, from the Cœur d' Alene Railway & Navigation Co. The building of one or two short links will thus give the company a short cut across Idaho, compared with its present long detour to the north. But a still more important cut-off is that which the company has now half completed across central Washington, leaving the main line at Spokane Falls and running west along the Spokane and Columbia River valleys to a junction with the main line again, not fer east of the Cascade tunnel. By the present line, from Missoula to the Cascade tunnel is about 625 miles. The new route will shorten this distance about 150 miles. It is probable that another year will witness the completion of this new line.

Mention has already been made of the Seattle Lake Shore & Eastern company's eastern division. The company is this year concentrating its efforts on the north and south line from Seattle to a point on the Canadian Pacific railway a few miles north of the border. Perhaps one reason why work was concentrated on this line was the desire to complete it ahead of a rival parallel line, the Fairhaven & Southern, projected to run from New Westminster to Seattle and thence to Portland, Ore. This company, which is headed by Mr. NELSON BENNETT, the veteran railway builder, has already begun tracklaying.

As will be seen by reference to our map and list, the number of independent enterprises in Washington and northern Oregen is very considerable. This section was strangely backward in development, considering its great natural advantages; but the past two years have seen rapid progress, and it is probable that the present activity will continue for many months. The aspiring cities which are being boomed by all the familiar arts of the Western land speculator are mostly on Puget Sound, and each of them is hoping that at an early day it may become the tidewater terminus of the Union Pacific and Southern Pacific systems. Neither of these companies, however, has made any definite move in this direction, although if the growth of this region continues, they are likely to do so.

In Oregon little is doing except in the extreme northern part, where the Oregon & Washington and the Oregon Railway Navigation Companies are competing for the traffic of a fertile wheat raising section. The Oregon Pacific seems to be making no better progress than in former years. Its board of directors includes many Eastern capitalists well able to push the enterprise to completion whenever the game is worth the candle; but for the present we conclude they deem it safest and most profitable to make haste slowly.

We have considered the surveys which the Union Pacific has made through eastern Oregon and northern California of sufficient importance to give one of them a place upon our map. The main object for the construction of this line would seem to be the securing of a through line to San Francisco entirely independent of the Southern Pacific. The line would be somewhat longer than the present line of the Central Pacific, but it is quite possible that the extra distance would be more than compensated for by better grades. Nothing has been done on these surveys for some months, however, and whether the company intends to make any use of them is problematical. The proposed Union Pacific line from Salt Lake City to Los Angeles seems more likely to be carried to completion at an early day than the extension into northern California. Besides the local traffic from the mining districts, which is claimed to be considerable, this line would draw a goodly amount of the tourist travel to southern California which now goes over the Santa Fé and Southern Pacific lines. If favorable grades can be secured, a large coal traffic might be carried from Wyoming and Utah to California.

The proposed line down the Colorado cañons is shown on our map a little east of the Union Pacific line. The principal business which the promoters of this line hope to secure is also coal and tourist traffic. A full account of this enterprise may be found in our issue of Sept. 21, and in other numbers of the present volume.

In California the principal activity is still in the southern section. San Diego is anxious to secure a direct outlet to the east and northeast, and seems likely to have its wishes realized next season. This section is now undergoing the inevitable reaction following the flush times of the past three years; but it has enough natural resources and its attraction for health seekers is such that its steady and more healthy growth is likely to continue.

The Southern Pacific is not doing as much construction this year as last; but about all the California construction except in the Los Angeles and San Diego section is on its lines. The most important enterprise planned by the company is the tunneling of the Coast Range north of San Luis Obispo and the completion of the missing link needed to make a second through line from San Francisco to Los Angeles. The several projected lines to parallel the Southern Pacific up the San Joaquin Valley do not seem to progress very fast. The small prospects of success in competing with a corporation so well intrenched at every point as the Southern Pacific is in California, is evidently appreciated by the "would not-be" bondholders of these rival companies.

Work in Utah is confined to the vicinity of Salt Lake City. What is really the most important work now in progress in the State is the change of gauge of the Rio Grande Western. Since it is not new construction, it is not shown upon our map. The work in progress, however, amounts to nearly a rebuilding of the line, since curves and grades are being cut down, and new bridges and culverts of first-class type are being put in. With the completion of the line now under construction by the Denver & Rio Grande down the Grand River to Grand Junction, on which a third rail will be laid, a new standard gauge route will be open from Ogden and Salt Lake City east to a junction with the important systems centering at Denver, Colorado Springs and Pueblo.

The Denver & Rio Grande is doing considerable work in Colorado besides the building of the line referred to above; and there are enough independent enterprises in the southern portion of the State to make the outlook fairly good for engineers and contractors in this section for some time to come.

In New Mexico and Arizona there is but little progress to report. The facts seem to be that until the irrigation enterprises in this very hot and arid region are in operation, the prospects for railway traffic are too uncertain for railway construction of any amount to be carried on, except where short branches are built to reach mining districts.

A new line to Mexico from Deming, N. M., south is now under way, and is projected to run to Chihuahua and Guaymas.

The former city is now reached by the Mexican Central and the latter by the Sonora Railroad; and it has not been generally understood that either city overburdened with traffic the railway leading north from it. However, the new enterprise is backed by a Government subsidy of $13,000 per mile; and its projectors will probably be content to carry a light traffic for awhile.

The map of southern Texas shows lines which were beyond the limits of our map of Sept. 28. Most important are the extensions of the San Antonio & Aransas Pass system, which is one of the very few independent enterprises organized within the past four years which have achieved success and bid fair to maintain their independence. With the extensions from Houston east, the northern line to Waco, and the direct line to Laredo, to meet the Mexican National, the company will be in a still stronger position as regards Texas traffic.

As a whole the outlook for railway construction in the States of the Rocky Mountains and Pacific region is certainly favorable. There is an abundance of wildcat enterprises here, of course, perhaps more than in other sections; and there are great tracts of country which can never support more than a thin population, and can offer practically no traffic to a railway. On the other hand there are vast areas which, when improved by irrigation, will be cut up into productive farms; there are other areas covered with still untouched timber, every year growing more valuable; and in almost every State of this section there are stores of precious or useful metals and minerals, which will eventually cause the building of other networks of railway lines similar to those already in operation in Colorado and Montana.

A New Type of Long Span Bridges.

The strikingly graceful design for what we may call a "cantilever arch" of 820 ft. span, which we illustrate by an inset sheet this week, is, if we mistake not, well worthy the careful study of bridge engineers, as not only an economical but a most graceful type of construction. It will be generally admitted to be upon its face an economical type. Without pretending to have investigated the matter analytically, it strikes us that for large spans which yet are not too large, say from 600 to 1,300 ft., this ought to be nearly if not quite the most economical of all. The foundations are certainly reduced to their minimum in this type, being of small height, and having only vertical or nearly vertical loads to sustain, while the bracketed cantilever "shore spans" greatly relieve the central "arch" members from what would otherwise be very heavy dead load strains. A just comparison, it seems to

us, should show that the type uses metal most economically, and so that for the locality shown and others like it, where a considerable depth as well as width is to be bridged, it would be impossible to design a cheaper structure of any type.

But the point to which we now wish to call particular attention is the exceeding grace of the design, as compared with its neatest prototype, the cantilever, as illustrated in the Niagara, Kentucky River, and Frazer River bridges. Whatever other merits the cantilever has, it cannot be regarded as a particularly graceful structure. The design herewith is conspicuously so, and it appears to us might easily have been made still more so. The great central span could hardly be improved in this respect, having all the grace of the arch, that most graceful of all engineering types; but the lines of the end spans might easily have been improved by making the short abutment span of unequal instead of equal height, so as to make it in appearance a part of the shore arm of the "cantilever," and by then making the under side of the shore arm a single curve from the abutment to the pier, instead of the rather ugly combination of straight line and curve shown on the design. For the same reason, it would seem as if it would have been more truly artistic, and little if any more expensive, to have given the sides of the short abutment span the same outward flare as the sides of the main structure, instead of making a sharp break in the lines of the structure, and so making the abutment span an evident and to the layman a puzzling feature, apparently resting at one end on nothing.

In fact the structure is of so unusual a type that the theory of its design is not instantly evident even to the engineer. It consists simply of two great balanced or "teetering" beams, the two arms of which are of the unequal lengths of 410 and 180 ft., thus giving enough excess of weight to the longer arm to (1) overbalance the dead weight of the shorter arm and of one end of a short 80 ft. span connecting it with the abutment, and (2) overbalance any live weight which can come on the shore span, so that under no conceivable circumstances can the center of the main span tend to rise.

Under these conditions, the first effect of a load entering upon the bridge is to relieve the great main "arch" of dead weight strains, which in no case are very considerable, since the greater portion of the strains are transmitted to the pier directly through the long central strut. As the load advances over the central span, there are true arch strains created within the structure, due to the live load, as well as the excess of a dead load; but the advantages of the design in permitting the concentration of material into a few great members, and in permitting the strains to be favorably transmitted under all conditions of loading, are still obviously great.

The purpose of the short independent landing span, we take it, is simply to make all the strains determinate and constant, under all conditions of temperature and vibration under load, by avoiding the rigid connection of the shore arm with the abutment which would otherwise be essential. It might appear that this would have a tendency to decrease the rigidity of the structure, but we are assured that calculation shows this not to be the case, while its advantages in simplifying the strain sheet computations and keeping the maximum strains within narrower limits are very obvious.

As a whole, it will probably be generally admitted that this is a type of bridge worth study, and worth practical use in localities suited for it, where a great height as well as great width is to be bridged. A comparative study of the theoretical capabilities of the type as compared with the arch, suspension bridge and cantilever, would be a matter of interest, and might perhaps show that in some of the views expressed in this article we have been mistaken; but it seems to us that it would be likely to make a more favorable rather than a less favorable showing; besides which, the æsthetic question is entitled to great weight in localities calling for such grand structures. Should any of our readers feel moved to make such a theoretical comparison, we shall be pleased to give space to it.

CORRESPONDENCE.

The Howe Truss Strut Problem.

Canadian Pacific Railway, Engineers' Department,
MONTREAL, Nov. 21, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

MR. D'ARMIT'S method of finding the length of the strut of a Howe truss, published in your issue of the 16th inst., seems to invest the subject with altogether too much mystery and mathematics.

As the sides of the angle blocks must be calculated, surely the shortest way to find the length of the strut is to deduct the half length and height of the block from the height and length of the panel, and find the length of the strut as the hypothenuse of a right-angled triangle.

The solution of the bi-quadratic for finding the sides of the angle block is extremely simple, since one can tell approximately the required root of said equation by drawing the panel to scale and guessing at the position of the strut.

The bi-quadratic reduces to the form

$$(1)\quad x^4 - A x^3 + \left\{\left(\frac{A}{2}\right)^2 - d + \left(\frac{B}{2}\right)^2\right\} \times x^2 + A \times \frac{d^2}{2} \times x = \left\{\left(\frac{B}{2}\right)^2 \times d^2 - \left(\frac{d^2}{2}\right)^2\right\}$$

in which A = length of panel; B = its height; L = length of strut; d = its width; x = base of angle block; y = its height.

The following calculation was made for a Howe truss a few months ago:

$A = 12$ ft., $B = 20$ ft., $d = 10$ ins. $= 0.833$ ft.

Equation (1) then takes the following form for solving by HORNER'S method:

$$(2)\quad 1 - 12 + [36 - 0.833 + 100] + 4.164 = [69.4 - 0.12]$$

from a scale drawing x seemed to be about 9 ins.; therefore 0.7 was tried as the first figure of the root, and the full calculation stood as below:

$$(3)\quad \begin{array}{rrrr} 1 - 12 & +135.167 & +4.164 & = 69.28\ (0.722 \\ -12.9 & +13516.7 & +4164 & 6628.0 \\ 7 & -791 & 88079.0 & 6527.7 \\ \hline -11.3 & 12725.7 & 92243.9 & 101.2.7 \\ 7 & -742 & 89885.9 & 4000271.0 \\ \hline -10.6 & 11983.7 & 177129.8 & 3587.8.36 \\ 7 & -693 & 177129.8 & 42.58464 \\ \hline -9.9 & 11290.7 & 2254468 & \\ 7 & 1129070 & 179384298 & \\ \hline -1.2 & -1896 & & \\ \hline -9.29 & 1127234 & & \\ 2 & & & \\ \hline -9.18 & & & \end{array}$$

x is therefore $= 0.722$ ft. $y = \sqrt{d^2 - x^2} = 0.415$ ft. and

$$L = \sqrt{(A - x^2) + (B - y)^2} = 22.6 \text{ ft.}$$

H. IRWIN.

[Mr. D'ARMIT'S idea was probably not to determine a method of approximation for practical use—that can be best done by a drawing without any computation at all—but to determine an exact mathematical solution. This, however, Prof. DUBOIS did in our last issue much more simply than Mr. D'ARMIT.

Prof. DU BOIS calls our attention to the fact that the analytical solution we suggested last week in a note to his letter is not feasible, for the reason that the suggested mode results in a bi-quadratic equation, which cannot be solved generally.

We can publish nothing more on this problem, excepting only several articles, for which cuts are being made.—ED. ENG. NEWS.]

A Conflict of Quotations.

ST. JOHN, N. B., Nov. 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In the Introduction to HASLEY'S "Railway Masonry and Bridge Foundations," published in 1883, appears the following sentence:

"Though superstructure should decay and drift away, though embankments should crumble and wash out, masonry should stand as one great mass of solid rock, firm and enduring."

It appears to be original with Mr. HASLEY, as it bears no quotation marks.

In the Introduction to Prof. BAKER'S "Treatise on Masonry Construction," recently published, the sentence is inserted as follows:

"The first cost of masonry should be its only cost.

"*Though superstructures decay and drift away, though embankments should crumble and wash out, masonry should stand as one great mass of solid rock, firm and enduring.*—Anonymous."

There is evidently a slight error somewhere.—M.

[Apparently the sentence originated with Mr. HASLEY, but the sentiment is good enough to have deserved frequent quotation, and perhaps it has had it.—ED. ENG. NEWS.]

End-Area and Other Earthwork Formulas.

SCRANTON, Pa., Nov. 11, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

I was rather staggered at your remark in the last number of ENGINEERING NEWS that averaging end-areas did not always give an excess. How? When? Where? Why? It seems to me the limits are, equal end-areas, when result is correct, and a pyramid or cone, when the error is 50 per cent excess. It would seem that all cases must be between these extremes.

Furthermore, I think the prismoidal formula a huge mistake. It only applies, as far as I know, when the mid-area is symmetrical with and proportionate to the end areas; that is to say, points of mid-area must lie in the straight line joining corresponding points of end-areas. Suppose you had two equal pyramids, base 1 sq. ft. and height 3 ft., juxtaposed by the bases. Their combined volumes = 2 cu. ft. Per prismoidal formula, we would have volume = 4 cu. ft. Now no three equidistant sections taken on the ground ever fulfil the requirements, and a calculated mid-area, if laid out on the ground, would be sure to be way off the reality. The only way, in my humble opinion, where accuracy is required, is to multiply the sections, that is, reduce the distance separating them, and average them—*only using measurements actually taken on the ground.* Any fictitious data, created in the office, are of no worth whatever.

Yours truly, S.

[There was once a famous reviewer of books who explained that he never read a book he was going to review, because he found that "it prejudiced the mind." Our correspondent seems to be in much the same state of mind about the prismoidal formula, for he did not take the trouble to understand it sufficiently well before writing about it to compute correctly the little illustrative solid which he advances. Its true volume by the prismoidal formula (in so far as the prismoidal or any other formula can be applied to such a combination of two solids, which is not at all) is $V = \frac{0+4\times1+0}{6} \times \frac{6}{6} = 0.67$ cu. ft. instead of the true volume of 2 cu. ft., a tolerably sizable error, but not quite so large as would happen in applying the end area method to the same solid, which would give a solidity of *zero*, being one of the cases about which our correspondent is so anxious to learn, where the end area method gives too small a solidity. Another is a right-angled triangular pyramid, in which one end section is a vertical line and the other a horizontal line, the volume of which is correctly given by the prismoidal formula; and still another (the only practical case) is when the deepest center height happens to be at one end of a solid, and the greatest width at the other end; a rather rare case, but still one which does occur.

But it is an entire perversion of reason and fairness to take such a solid as the double pyramid above described as an example. All railway and other earthwork is supposed to be so cross-sectioned in the field that the surface between any two corresponding stakes or fixed points is sufficiently near to a right line to be regarded as such; that is, in a railway prismoid, the two slope-stakes on each side, and the two center stakes, are supposed to be connected by longitudinal right lines, and if they are seen not to be so connected in the field, intermediate cross-sections must be taken. This is a fundamental requirement for any system of earthwork measurement; and this being so, after the field measurements are made and the era of office computation comes on, it is entirely unwarrantable to assume *then* that the field work has not been properly done, on which assumption our correspondent bases his whole argument.

The point is that, granting such properly cross

sectioned solids, the prismoidal formula applies to any and all of them correctly, and in the simple form of applying it which we described, without any sensible addition to the office work; while the end-area method does not apply to any of the solids correctly, except those in which either the center heights or distances out are the same, and to those solids in which these dimensions differ considerably, it results in a very great error. For instance, if two end sections differ 10 ft. in center height, the simple interposition of another section will add about 50 cu. yds. to the end area volume, although the actual surface may have been perfectly defined by the notes in either case. Our correspondent's understanding of the limits of the prismoidal formula is perfectly correct in a practical sense, although that remarkable formula also applies to spheres, spheroids, hemispheres, ellipsoids, and multitudes of other peculiar solids, as well as to all solids which are bounded by hyperbolic paraboloids, as railway solids which are not planes on top are necessarily assumed to be. But our correspondent's error lies in supposing that any kind of decently taken field notes fail to define the surface with the exactitude called for by his definition of limits. That it is necessary to actually calculate the mid section in order to apply the prismoidal formula, as our correspondent implies, is not the case.—ED. ENG. NEWS.]

Eliminating Facing Point Switches.

NEW YORK, Nov. 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

The plan suggested by X. P. T. for "Eliminating Facing-Point Switches on Double-Track Lines" has merit worth discussing, even if it is not entitled to a claim for novelty.

Such a device has had frequent presentation in past years and I feel certain has been used, but am unable to locate the application.

Many managers object to increasing the use of crossing frogs in the main track, unless conditions make it extremely desirable. Such conditions would have weight in proportion to the amount of traffic particularly facilitated by their use.

As a matter of maintenance, the number of switches remains as before.

Five frogs are used instead of three and the length of track is decreased, but the skill and care required is increased, while the wear and tear effect on the rolling stock is not so desirable as in the old way.

If the station requirements are such as is indicated by the scale, showing a clear-siding not over 500 ft., then it would appear that all the service might as well be furnished over a switch at one end of the side track only, namely, at the trailing point, and a trailing point cross-over road provided there instead of at the other end of the yard.

The writer is conversant with scores of cases where changes have been made resulting in such an arrangement with a great increase of safety to the speed train service and but little trouble to the local freight work.

With the yard as per plans, all switching ought to be done at the trailing point end, but if the yard increases in importance and acquires other rear tracks, so that switching must be done from the other end, then with the single slip the train must cross over and flag and use both tracks. Such an advance on a busy railway would soon lead to the introduction of a facing point again, either in the old way or by double-slipping the cross frogs, and when this is done the most complete thing would be to properly equip the place with interlocking, which is the most practicable way to eliminate the objections to necessary facing points.

On a road with block signaling and interlocking it might be worthy of serious consideration to use for a small station a side track connected at the trailing end only with one main track,—that is, a single slip,—and cross-frogging to a facing point on the next main track, substantially just the opposite of the arrangement as shown on the plan referred to; and all to be properly connected and under the control of and signalled from a tower at that point.

Such an arrangement of switches is the proper thing for a single-track branch off from a double-track trunk line. H.

The Price of Aluminum.

NEW YORK, Nov. 25, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

We were much interested in the remarks about aluminum transits, in your issue of Nov. 23, as we are making such transits now. What specially interested us was your statement that the price of aluminum was $2 per lb. You certainly have some basis for this quotation, and we would thank you to kindly give us what information you have, because the price which we have to pay, and do pay after looking around, is out of all proportion to the price you name.

We look forward with pleasure to receiving above information, and are

Yours respectfully,
KEUFFEL & ESSER CO.

[We print this letter and make the following answer for the benefit of our correspondent and those instrument-makers generally who are a little careless in reading ENGINEERING NEWS. In our issue of NOV. 2 was a short editorial on the remarkable reduction in price, and for several issues we have carried a conspicuous advertisement of the Pittsburg Reduction Co. relating to the $2 price, and stating that this price was for 1,000-lb. lots.—ED. ENG. NEWS.]

The Belle Isle Dam.

NEW YORK, Nov. 22, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In a recent extract from a newspaper quoted in your periodical, it is stated that the plan of modifying the climate of America by closing the Straits of Belle Isle is an old one, and was even advocated by MAURY and was by him proposed to the English Government thirty years ago.

If so, it is singular that the English Government did not know the fact of such a report, and only a few years ago sent a commission to examine the possibility, after it was suggested by myself. The Canadian Government seemed also to be ignorant of any such proposition.

There is a further point of interest in the fact that all the arguments against its possibilities were quotations from MAURY, and that his whole theory of the circulation of ocean currents had to be combatted to show the possibility of the plan.

It is rather amusing, after having read the caustic criticisms of scientific papers for years on this plan, and being referred to as the originator of a scheme beyond the wildest vagaries of JULES VERNE, that it now looms up as a feasible plan, originating with a man whose every theory was opposed to it. Yours,

JOHN C. GOODRIDGE, JR.

[We agree with Mr. GOODRIDGE, that this is hard usage; and the only plausible explanation of this radical change of front probably lies in the fact that some one wishes now to connect Newfoundland with the mainland by a railway, and this dam for changing the climate of eastern America would fit well into the later scheme as a railway roadbed. Mr. GOODRIDGE made an exhaustive study of MAURY and his theories in 1885, when this project was prominently discussed, and should certainly know whether or not any such plan had been suggested by MAURY, as stated. But as the chief work of our correspondent, at that time, was to refute the theories of Lieut. MAURY, which were all opposed to a probable or possible change in conditions by a dam, the originality of the suggestion doubtless lies with Mr. GOODRIDGE, who offered it then only as an interesting topic for discussion. We have never before heard of Gen. Sir SELBY SMITH in this connection, though he is supposed to have advocated a similar plan in 1879.—ED. ENG. NEWS.]

PERSONAL.

Mr. H. C. KELLOGG has been elected engineer of the Anaheim Irrigation District, Anaheim, Cal. Mr. J. D. SCHUYLER, of San Diego, will be Consulting Engineer.

Mr. JOHN B. PECK, who has been General Manager of the South Carolina Railway for seven years, has resigned.

Mr. C. M. WARD, who has been Superintendent of the Pittsburg Junction division of the Baltimore & Ohio, has been appointed General Manager of the South Carolina Railway under the receivership.

Mr. W. F. MEATH, of Memphis, and ARTHUR ROBINSON, Superintendent of the Bayou Sara branch of the Mississippi Valley road, have been appointed to the respective superintendencies of the Memphis and Riverside Divisions of the road. Captain SHARP retains the superintendency of the New Orleans Division.

Mr. WATSON H. BROWN has been appointed receiver of the Cincinnati, Jackson & Mackinaw road, by the United States Court, at Cincinnati. This action was taken upon the confession of a judgment for $228,397 in favor of WILLIAM STEWART TODD, of New York.

Mr. W. A. LUTES has resigned as Superintendent of Bridges and Buildings of the Southern Pacific at New Orleans, La., to accept the position of Superintendent of the Merchants' Terminal Bridge at St Louis, Mo.

Mr. WM. H. DELEHENTY, General Manager of street-car lines in Long Island City, owned by the Steinway & Hunter's Point Railroad Co., has resigned. He will be succeeded by Assistant Superintendent MOULTON, of the Fourth Avenue Line of New York City.

Mr. J. W. MCKEE, Acting Superintendent of the Cincinnati Division of the Chesapeake & Ohio, has been transferred to the Richmond, James River & Peninsular Division as Assistant Superintendent, with headquarters at Richmond.

Mr. CHAS. A. MIXER, Chief Engineer of the Providence Cable Tramway, Providence, R. I., has not resigned, as was stated last week. On the contrary he has been given large responsibilities in connection with this work.

Mr. GEORGE B. HAZELHURST has been appointed Superintendent of Motive Power of the Baltimore & Ohio, the appointment to take effect Dec. 1. By order of the directors, the rolling stock of the road is to be largely increased, and a good deal is to be done in the way of improving its terminals.

Mr. S. H. ROBERTSON, formerly Superintendent of the O. & N. division of the Louisville & Nashville, has been transferred to the first division of the Knoxville branch, as Assistant Superintendent. Mr. JOHN LOYSDEN, of the Nashville, Florence & Sheffield, has taken Mr. ROBERTSON'S place. Mr. W. S. MARTIN has been made Assistant Superintendent of the Nashville, Florence & Sheffield.

Mr. MAX E. SCHMIDT, C. E., formerly Chief Assistant Engineer South Pass Jetties, and late Chief Engineer of the Tampico Division, Mexican Central Railway, has opened an office at No. 1138 "The Rookery," Chicago, Ill., for general civil engineering and contracting. Mr. SCHMIDT invites correspondence on Central and South American projects.

Mr. T. O. MORRIS, Engineer of Maintenance of Way on the Chicago Division of the Big Four, in addition to his other duties, is to have direct supervision over all bridges, buildings, tracks and roadway, reporting to the Division Superintendent.

Mr. JOHN KINSMAN, of Salem, Mass., died at his home on Nov. 16. He was for several years Superintendent of the Eastern Railroad. Later he went to Ohio, where he was Superintendent of the Mud River Railway, and was one of the founders of the gas company that first introduced gas for street and house lighting in Springfield, O. On his return to Salem he was made Superintendent of the car-shops.

Mr. W. S. MARTIN, formerly Trainmaster of the Nashville & Decatur division of the Louisville & Nashville, has been appointed Assistant Superintendent of the Nashville Division, and of the Nashville, Florence & Sheffield Railway, with headquarters at Nashville. The authority of Mr. C. S. EVANS, Master of Trains of the Second Division, Main Stem, is extended over the line between Nashville and Decatur.

Col. DARIUS ALDEN, of Augusta, Me., died Nov. 21. It was Col. ALDEN who conceived the idea of buying up the old Portland & Kennebec Railroad, and with nine others he bought a controlling interest for $130,000. The road flourished beyond their expectation, and from it grew the now wealthy Maine Central Railroad Co., of which Col. ALDEN was the heaviest individual stockholder, owning 2,670 shares.

Sir SAMUEL MORTON PETO, of London, died recently. The firm of which he was a member was awarded the contract for building the new House of Parliament, but in 1845 Sir SAMUEL withdrew from the firm, and the work was continued by his former partner, THOMAS GRISSELL. Sir SAMUEL then devoted himself to railway building, and was interested in the construction of the leading lines in England, besides building roads in several other countries. He was at one time a member of the House of Commons.

Mr. T. C. LEAKE, Jr., Vice-President of the Tennessee Midland Ry. Co., and President of the Alabama Land & Development Co., died at Richmond, Va., Nov. 16. When the Richmond & Alleghany Railroad was to be built Mr. LEAKE, and associates took large contracts to furnish ties, etc. He then took a contract on the Georgia Pacific Railroad, and also built a large part of the Memphis, Birmingham & Atlanta Railroad. Until about a year ago, he was President of the Virginia Construction Co. This he resigned, and was succeeded by Col. A. S. BUFORD, and until recently he was President of the Virginia & Alabama Coal Co., and this also he resigned and was succeeded by Mr. J. B. PACE.

A new firm of patent attorneys has been organized by Congressman BENJ. BUTTERWORTH, of Ohio, who was the Commissioner of Patents under President ARTHUR; BENTON J. HALL, who was the Commissioner under President CLEVELAND; FRANK T. BROWN, formerly principal examiner in charge of the electrical division of the Patent Office; and A. P. SMITH, M. E., also a former member of the examining corps of the Patent Office. Offices have been opened at Washington and Chicago, and others will be established later at New York and Cincinnati.

Col. HIRAM H. FISHER, a civil engineer and well known manufacturer of iron pipe, died at his home in Allentown, Pa. on Nov. 23, aged 57 years. Col. FISHER was born in Hamburg, Berks County, Pa., but early removed with his parents to Harrisburg, where he was educated at the Harrisburg Military Academy, having among his schoolmates Hon. J. DONALD CAMERON, Gen. HORACE PORTER and others now well known in public life. He selected civil engineering as a profession and about 1850 he was assistant to Mr. HARRY NICHOLS, now Chief Engineer of the Philadelphia & Reading R. R. Co., and later was with Mr. GEO. B. ROBERTS, present President of the Pennsylvania R. R. Co. In 1856 he was connected with the Allentown R. R. Co. and then for some years after he was a mining engineer in the coal regions of Pennsylvania, becoming Chief Engineer and General Agent of the Union Coal Co. He was also the Engineer of the Howard Coal & Iron Co.'s R. R., now a part of the Lehigh & Susquehanna R. R. In 1866 Col. FISHER located in Allentown, Pa., and built the Fisher Foundry, where he was first engaged in making car-castings, but in 1873 he commenced the manufacture of iron pipe by a process of his own invention and established the now well-known Fisher Pipe Manufacturing Co., of which firm he was President at the time of his death. Col. FISHER was one of the most courteous genial, and kind-hearted of men, and a host of friends will mourn his loss.

Railways in China.

The proposition to build extensive railway systems in China has met with numerous reverses, and is now apparently rejected. The press, however, is keeping the question alive, and the agitation will almost certainly result, sooner or later, in the establishment of railways supplementary to the existing line, 82 miles long, which was described in ENGINEERING NEWS, Dec. 22, 1888.

The *North China Daily News*, of Shanghai, on Oct. 1 contained a translation of a report by the Board of Admiralty on CHANG CHI-TUNG's memorial on railways.

LIU MING-CHUAN advocates a line from Taku and Tientsin to Peking; HUANG P'UNG-NIEN is in favor of first building a "frontier railway," and later on others in various parts of the interior as strategic purposes demand, but thinks that after the "frontier railway" (to which he gives paramount importance) has been built, a line should be built from Tientsin to T'ungchow as an experimental step. For the railway already built from Tientsin and Taku to Su Koh-chuang, and for the survey of the ground for the proposed continuation of it to Tungchow and the purchase of materials, sums amounting in all to $1,800,000 were borrowed from foreigners at 5 per cent. The strategic railway from T'ang-shan to Shan Hai Kuan must be postponed until the budget is in a more flourishing condition.

The suggestion that native iron should be used for rails is not approved by the Board. In 1883 when the Tsung-li Yamen wrote to the Governor of Shansi about the opening of iron mines in that province, CHANG CHI-TUNG forwarded a piece of iron which one of the members of the present Admiralty, LI HUNG-CHANG, had examined at the time by experts, who found it very badly refined and full of impurities. A foreign iron refining plant of medium quality will cost about $2,100,000, and to set up two such would cost $4,200,000, and these could not be conveyed to those places without the aid of rails bought abroad. At present Shansi iron is actually dearer than foreign iron, and the expense of preparing it and making it into rails in China would make the outlay enormous. The Admiralty therefore strongly recommend that both main and branch lines be built with rails imported from abroad, before any steps are taken for the utilization of Shansi iron for making rails.

The first section should certainly be from Hankow to Sin-yang in Honan, and then gradually northward; this being a short section, and running through the richest and most populous country, and therefore the most likely to make an immediate return for the outlay on its construction.

Three sources of supply, Government subsidies, native loans, and foreign loans, will all have to be called into requisition; first of all, a substantial Government subsidy to make an encouraging beginning, for the Chinese merchants are not likely to come forward and invest their money until they see that something has been done.

The viceroys and governors of the provinces to be traversed must notify gentry and people that they are to offer no impediment to the progress of the work. In ten years, if all unite to further it as the Admiralty hopes, China will be in possession of a railway from Lu-kow to Hankow. The report concludes with some remarks on the increased wealth and greater power of self-defence which railways will give to China, and recommends that high officials of the necessary experience and of unimpeachable integrity should be employed.

This report certainly shows that the subject is receiving careful consideration by the authorities, but the superstitious and conservative members of the government and its departments have so far been able to prevent anything definite from being done. The daily paper above referred to has the following in its issue of Oct. 14:

> The construction of more railroads in China is indefinitely postponed. One reason for this decision, or rather for this revocation of the Emperor's recent decision, is the destruction by fire of the Temple of Heaven; but the real reason is the want of money. The Government will not make a large foreign loan; there are no funds available in Peking, and the provincial governments profess their inability to find any. There is plenty of money in China, but as we have often pointed out, those who have it will not lend it to an official undertaking. Nothing could surely be more hopeless than the present state of things in Peking. The Empress Dowager, the Emperor's father, and the more intelligent high officials are strongly in favor of building railways, and the Emperor has been induced to state in a decree that "to make a country powerful, railways are essential"; but there is an immovable mass of ignorance and stupidity at the capital against which the waves of progress beat in vain, and it, aided by the thunder storm of Sept. 18, has proved its invincibility once again.

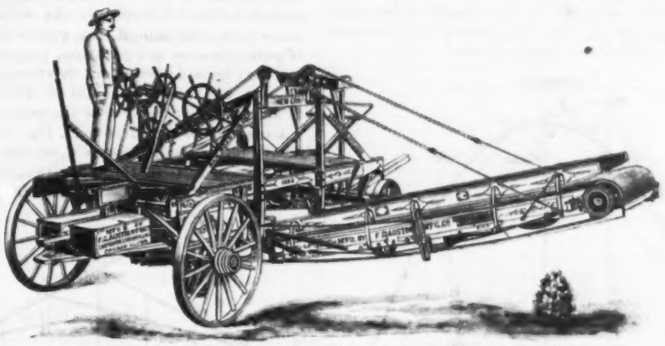
THE TICKET COMMISSION EVIL was discussed at the meeting of trunk-line presidents on Nov. 19. The resolution of a year ago, condemning the practice, was reaffirmed, and measures were taken looking to the suppression of the practice in New England and the West, as well as in trunk-line territory.

The Austin Grading Machine.

The multiplication of railroads and canals, and the building of levees, irrigation ditches, etc., has made earth-handling by steam a practical necessity. Many machines have been invented to accomplish this end economically and expeditiously, and among the latest is the machine here illustrated.

This is the "New Era" grader, ditcher and wagon loader as improved and now offered to the public. It is the product of twenty years' experience in the manufacture of similar machines, and is especially adapted for the building of railroads, highways, and dykes, or for cutting down banks and digging irrigating ditches and canals. The grader will work in any soil where a plow can be used, and is supplied with carriers of various lengths to conform to the depth or width of the work under construction.

The makers claim that, with six teams and three men, it is capable of excavating and placing in embankment from 1,000 to 1,500 cu. yds. of earth in 10 hours; or of loading from 600 to 800 wagons in the same time. The cost of this handling is given as 1½ cts. to 2½ cts. per cu. yd., as compared with plow and scraper work at about 8 cts. per cu. yd. A gang of 25 men and 20 teams, with plows and scrapers, must work steadily in order to handle 1,000 cu. yds. of earth per day; while 15 men with 18 teams, and 3 of the machines here described, will easily place in embankment from 3,000 to 5,000 cu. yds. in the same time, at a net saving of from $180 to $300 per day to the contractor. While this claim must be considered as exaggerated by many, it must be remembered that this machine has the advantage over other earth-handling appliances of doing its own excavating, and at the same time it carries the earth where it is wanted, either in embankment or on wagons. Any further particulars can be obtained by application to the F. C. Austin Manufacturing Co., of Chicago, Ill.



The New Era Grader, Ditcher and Wagon Loader.

A Manual of Railway Field Work and Laying Out of Works.

ACCORDING TO THE MOST RECENT AND APPROVED PRACTICE ON AMERICAN RAILWAYS.

BY A. M. WELLINGTON,
M. Am. Soc. C. E., M. Inst. C. E., etc.

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[The author will be pleased to receive typographical or other corrections, or suggestions as to form or substance, from any interested reader. All such suggestions will have full consideration.]

CHAPTER II. THEORETICAL PRELIMINARIES

[*Continued from p. 476.*]

THE PARABOLA is entirely unsuited for use as a railway curve, for the reason that it has only a single trifling advantage over a simple circular arc, to which in most cases it closely approximates, while much less easily laid out and otherwise less suitable for general use. The radius of the extremities of a parabola, for ordinary arcs, is but slightly longer than that of a circular curve, while the center of the curve is considerably sharpened. It thus alleviates very slightly, often inappreciably, the only objection to the use of simple circular arcs, the abrupt transition from a straight line to a curve. But the mathematical theory of the parabola is for some purposes much simpler than that of the circle, and the very fact which makes it unsuitable for general use, its close approximation to the circle when flat arcs only are compared, makes some knowledge of its theory and properties indispensable for the advantageous conduct of field-work.

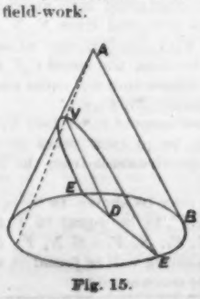

Fig. 15.

A parabola, *E V E*, Fig. 15, is the curve generated by the intersection with a cone of a plane parallel with the "side" or generatrix of the cone *A B*. The point *V*, where the plane of the parabola is cut by a plane, *A B V D* perpendicular thereto, and passing through the apex *A* of the cone, is called the *vertex*, and the line *V D* is called the *axis*, and bisects the curve. The extremities *E E* of the parabola extend, or may be extended, indefinitely into space.

From any point (in the same plane) without a parabola, as from without a circle, two tangents may be drawn to it. If the point be on the axis prolonged, the tangents will be equal. If the point be on either side of the axis, the tangents will be unequal. The radius of curvature of a parabola is constantly changing, being shortest at the vertex V, and thence increasing by a regular law to infinity at its extremities in space. Fig. 16 shows to scale the parabola $E\,V\,E$, Fig. 15, generated in the cone $A\,B$. If the point A, Fig. 16, be so situated that the two tangents from it include the vertex V, the minimum radius of the included curve will be at some point between the two tangent points, and will decrease from it each way. Otherwise, the curvature will be sharpest at one tangent point, that nearest the vertex, and the radius will increase regularly to the other tangent-point.

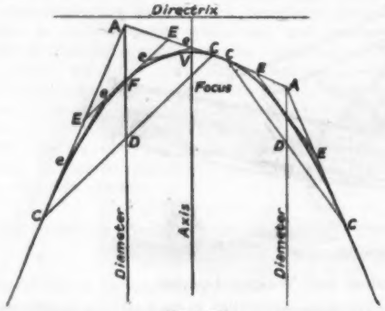

Fig. 16.

If from any point A, on Fig. 16, exterior to a parabola, two tangents be drawn to it, and the chord $C\,C$ drawn connecting the tangent points, a line passing through the point A, and parallel to the axis, is called a *diameter* of the curve and bisects the chord $C\,C$ in D. Furthermore, a line $E\,E$ parallel to the chord and bisecting the tangents $A\,C$ will be a tangent to the parabola, and will likewise bisect $A\,D$ in F.

It follows from this definition that we may draw two other diameters through the points $E\,E$, two further chords, $C\,F$ (not drawn in) and by again bisecting the sub-tangents $E\,C$, $E\,F$, obtain two new tangents to the curve, $E\,E$, $E\,E$, which will be tangent to the parabola at their middle point, and so on indefinitely.

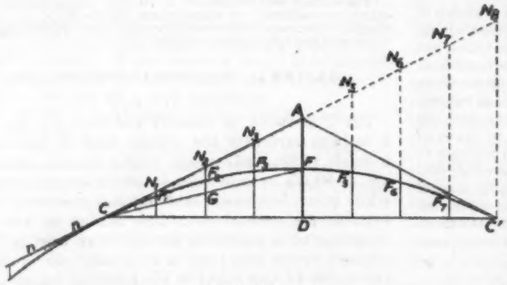

Fig. 17.

From these properties results, by simple geometrical reasoning, the following:

Let $C\,F\,C'$, Fig. 17, be any parabola, with tangents $A\,C$, $A\,C'$, equal or unequal, the diameter $A\,D$ being bisected by the curve at F. Let either tangent to the curve be subdivided into any number, n, of equal parts, as four, and lines $N_1\,N_1$, $N_2\,N_2$, etc. be drawn parallel with the diameter at each sub-division, thus sub-dividing the chord $C\,F$ and half chord $C\,D$ into the same number of equal parts, and cutting the parabola in F_1, F_2, etc.

Then will the respective *tangent deflections* $N_1\,F_1$, $N_2\,F_2$, $N_3\,F_3$, $A\,F$, etc. be to each other as the *squares* of their respective distances from the tangent point C or C' [1].

In like manner $N_1\,F_1$ may be shown to be equal to $\frac{1}{4}\,N_2\,F_2 = \frac{1}{9}\,A\,F$: $N_3\,P$, to be equal to $4\,A\,F = 64\,N_1\,F_1$; $N_2\,F_2 = 9\,N_1\,F_1$; $N_3\,F_3 = 25\,N_1\,F_1$, etc. A more general demonstration will be found in any Geometry treating of the conic sections.

[1] For in Fig. 17 we have geometrically $N_2\,G = \frac{1}{4}\,A\,F$, whence by the properties of the parabola, a line $N_2\,F$ (not shown) being tangent to the curve at F, $N_2\,F_2 = \frac{1}{4}\,N_2\,G = \frac{1}{16}\,A\,F$.

Furthermore: If either tangent, as $A\,C$, be prolonged, and subdivided in equal spaces of the same length and number, n, by points $N_3\,N_3$, the entire series of offsets $N_1\,F_1 \ldots$, $A\,F$, $N'_1\,F_1, \ldots$, $N'_3\,C'$, will continue to be to each other as the square of their distances from the tangent point C, and points thus fixed from $A\,C$ prolonged by offsets $N_2\,F_2$, $N_3\,F_3$, etc., will coincide with points fixed from the tangent $A\,C'$ by dividing it also into n equal parts and laying of from $A\,C'$ to same offsets, $N_1\,F_1$, $N_2\,F_2$, etc., as were laid off from $A\,C$.

If either tangent, as $A\,C$, be extended backward beyond the tangent point and divided into equal spaces, $n\,n$, by parallel lines, whether parallel to the diameter $A\,D$ or not, and a second series of tangent deflections differing as the square of the distance from C be laid off, the points thus fixed will be points in a second parabola, tangent to the first, and may be laid off without determining the second tangent, but the curve so laid off will not be, unless by accident, an extension of the same curve.

A tangent to the curve $G\,H$, Fig. 18, at any point F, will bisect the section $N\,C$, of one tangent and the section $N'\,C'$ of the other tangent prolonged; that is, in Fig. 18, $G\,C = G\,N$ and $H\,C = H\,N'$.

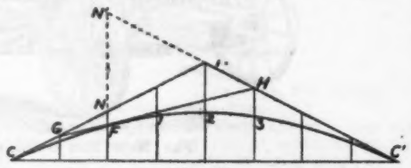

Fig. 18.

These various properties make the parabola a very simple curve to construct by fixing successive points on it. We have:

To lay out a parabola, given the tangents $A\,C$, $A\,C'$ equal or unequal, and chord $C\,C'$.

1. By bisecting tangents, as per method given above.

2. By tangent offsets. Bisect $A\,D$, Fig. 17 in F, divide each of the tangents into any desired number of equal parts n, and draw the lines $N_1\,F_1$, $N_2\,F_2$, $N_3\,F_3$, etc., through these points parallel with $A\,D$. The respective deflection distances or offsets at each succeeding station from the tangent point C will be to each other as $1^2, 2^2, 3^2 \ldots n^2$, or $1, 4, 9, 16 \ldots n^2$, and their absolute value, designating the first one by x, will be x, $4x$, $9x$, $16x$, etc., to n^2x. But letting the middle offset $A\,F = m$, we have $n^2x = m$, whence we have

$$x = \frac{m}{n^2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$

The value of x being once determined, we may fix points on the curve at all the offset-lines N_1, etc., and we shall obtain the same points whether we fix the entire curve from C to C' from the tangent $A\,C$ prolonged or start from each tangent point with the successive offsets x, $4x$, $9x$, etc. Or, at any point F, Fig. 18, we may determine a new tangent $G\,H$, and the successive tangent offsets 1, 2, 3, on each side of the tangent-point F will continue to be x, $4x$, $9x$, etc.

3. By intersections. Let $A\,P$, $A\,P'$, Fig. 19, be the tangents of a parabola, and $P\,P'$ the chord.

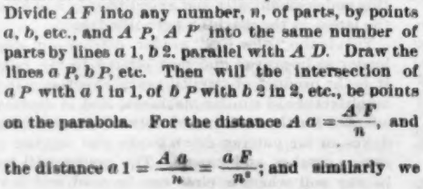

Fig. 19.

Bisect $A\,D$ in F and it will be a point on the curve. Divide $A\,F$ into any number, n, of parts, by points a, b, etc., and $A\,P$, $A\,P'$ into the same number of parts by lines $a\,1$, $b\,2$, parallel with $A\,D$. Draw the lines $a\,P$, $b\,P$, etc. Then will the intersection of $a\,P$ with $a\,1$ in 1, of $b\,P$ with $b\,2$ in 2, etc., be points on the parabola. For the distance $A\,a = \frac{A\,F}{n}$, and the distance $a\,1 = \frac{A\,a}{n} = \frac{a\,F}{n^2}$; and similarly we find the distance $b\,2$ to be $4\,\frac{A\,F}{n^2}$; etc.

By extensions of these methods we have:

To lay out a parabola from a single tangent, given the tangent $A\,P$ and tangent point P, Fig. 20:

1. By tangent offsets. Divide any part of the given tangent $R\,A$, into any number, n, of equal parts. Through A lay off in any direction any desired offset $A\,C = m$. Then for the first offset x at a we have (Eq. 29):

$$x = \frac{m}{n^2}$$

and $b = 4x$, $c = 9x$, etc. to C, or as far as may be desired beyond C. The tangent at any nth point c

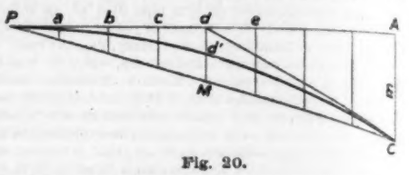

Fig. 20.

will be given by drawing the line $C\,d$ to the point d, $\frac{n}{2}$ stations from P, and if the chord $P'\,C$ be drawn, the tangent offset line $d\,M$ will bisect the chord and be itself bisected by the curve in d'.

2. By intersections, given the tangent $A\,P$ and tangent point P, Fig. 21, fix any point F through which the curve is to pass. Draw the line $A\,F$,

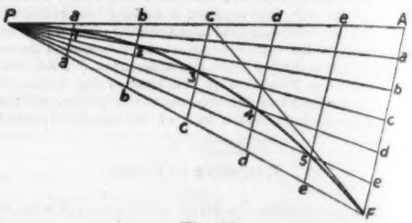

Fig. 21.

intersecting the tangent $A\,P$ at any angle; divide $A\,F$ into n equal parts; and divide the tangent $A\,P$ into n equal parts likewise by lines $a\,a$, $b\,b$, etc., parallel with $A\,P$. Then, as demonstrated in §—, will the intersection points 1, 2, 4, 5, of $a\,P$ with $a\,a\,a$, $b\,P$ with $b\,b$, etc., be points on a parabola tangent to $A\,P$ and passing through F. A different curve will be obtained, however, for every change in the angle $P\,A\,F$; but the difference will not be great.

The student should exercise himself in computing and drawing parabolic curves by the methods here outlined, in order that the general nature of the curve may be thoroughly understood; not that he will have occasion to actually lay out such curves upon the ground, for he will not, except occasionally as a quick way of interpolating points in a flat circular arc.

E. S. G. writes:

Be sure the tables of natural sines and cosines are like Henck's and Trautwine's (running from 0° to 45° only) and not like Shunk's (running from 0° to 90°). Try calculating latitudes and departures and you will see why.

It is intended to follow neither Henck nor Shunk in this matter, but to arrange the table of natural sines and cosines as in Henck (sines and cosines side by side, running from 0° to 45°) and the tangents and cotangents as in Shunk, running from 0° to 90°, tangents from top headings, and cotangents from bottom headings. In this way there is attained, first, a broad distinction between the sine and tangent tables, enabling them to be distinguished at a glance, saving frequent confusion and danger of error, and secondly, the important end outlined above of having the table of sines and cosines convenient for working a traverse. Except for this, the Shunk arrangement is on the whole the most convenient.

S. W. F. writes: "On page 451, Nov. 9, 1st column, near bottom of page, is the following:

Under this convention the *precise* formulas for the radius of practice (Eq. 1) become:

curves of 1° to 8°, $R = \frac{50}{Sin\ \frac{1}{2}\ D}$ ..... (2)

curves of 8° to 16°, $R = \frac{25}{Sin\ \frac{1}{4}\ D}$ ..... (3)

curves of 16° to 32°, $R = \frac{12.5}{Sin\ \frac{1}{8}\ D}$ ..... (4)

curves of 32° or more, $R = \frac{5}{Sin\ \frac{1}{20}\ D}$ ..... (5)

If D is in accordance with the previous definition, the angle at the center subtended by a chord of 100 ft., are (3), (4), a d (5) *precisely* correct? For instance in (4), a curve of 25 ft. does not subtend an angle of exactly ¼ D, but something less.

It was endeavored to explain with all possible fullness and clearness that although most of the older field books

define the degree of *all* curves as the angle subtended by a chord of 100 ft., thus throwing the radii out of all exact proportions to the "degree" of the curve, yet that the newer and better practice was that given in the "previous definition" referred to; viz., to use 100 ft. chords for curves of less than 8° only; 50 ft. chords for curves of 8° to 16°; 25 ft. chords for curves of 16° to 32°, and 10 ft. chords for curves of 32° or over—under which conditions the "precise" formulas for radii become those given above. The author is unable to use the English language so as to express all this more clearly than he did in the passage referred to, yet it seems that he was not successful in making this clear.

Statistics of Railway Construction.

ROCKY MT. AND PACIFIC STATES.

(Accompanying Map No. 20 of the Progress and Prospects of Railway Construction.)

WYOMING.—Existing Roads.

1. ***Chicago & Northwestern.***—Fremont, Elkhorn & Missouri Valley R. R.—Track laid in 1888, Glen Rock to Casper, 24.1 miles.

Chicago, Burlington & Quincy.—Burlington & Missouri River R. R.—Track laid in 1889, Alliance, Neb., to Wyoming coal fields, 100 miles.

2. ***Pacific Short Line.***—Graded, Sioux City, Ia., west 100 miles. Surveyed, 100 mile post to Ogden, Utah, 800 miles. President, Millard R. Jones, New York City; Chief Engineer, L. H. Clarke, Sioux City, Ia.; General Manager, Donald McLean, Sioux City, Ia.

3. ***Union Pacific.***—Carbon Cut Off Ry.—Under construction, Chimney Springs to Sulphur Springs, 17 miles. Cheyenne & Northern.—Partly graded, Wendover to Douglas, 70 miles. Surveyed, Eagle Rock, Idaho, to Yellowstone National Park, 65 miles.

Total.—Track laid in 1888, 24 miles. Track laid in 1889, 50 miles. In process of construction, 87 miles. Under survey, 445 miles. Projects of some promise, 325 miles.

MONTANA.—Existing Roads.

4. ***Northern Pacific.***—Track laid in 1888, Phillipsburg to Rumsey, 6.4 miles. Victor to Grantsdale, 15.2 miles. Track laid in 1889, Cañon House to Pipestone Hot Springs, 45 miles; Butte to Homestake Pass, 19.5 miles; Laurel to Red Lodge, 43.7 miles. Under construction, Pipestone Hot Springs to Homestake Pass, 15 miles; DeSmet to Superior, 40 miles; Boulder to Elkhorn, 21 miles; Sappington to Morris and Pony, 30 miles. Surveyed, Fort Benton to Billings, 225 miles. Under survey, Superior to Mullan, Idaho, 65 miles.

5. ***St. Paul, Minneapolis & Manitoba.***—Montana Central R. R.—Track laid in 1888, Great Falls to Sand Coulee, 45.7 miles; Silver to Marysville, 6.3 miles, Helena to Butte, 73.3 miles. Under construction, Sand Coulee to Belt Mountains, 30 miles. Under survey, Butte to Missoula, 120 miles.

Projects and Surveys.

6. ***Big Horn Southern.***—Projected, Custer to Casper, Wyo., 275 miles. A. J. Seligman; W. F. Sanders, both of Helena.

7. ***Montana & Canada.***—Projected, Fort Benton to Leithbridge, Alberta, 185 miles. President, Sir Alexander T. Galt, Montreal, P. Q.; Secretary, Hon. S. T. Hauser, Helena.

8. ***Montana & Wyoming.***—Projected, Billings to Cooke City, 125 miles. President, Chas. F. Roberts 150 Broadway, New York; Chief Engineer, P. M. Gallagher, Billings.

Total.—Track laid in 1888, 116.9 miles. Track laid in 1889, 99 miles. In process of construction, 136 miles. Under survey, 400 miles. Projects of some promise, 340 miles.

IDAHO.

(See Washington, Oregon, Montana, Wyoming and Nevada.)

Totals.—Track laid in 1888, 7.6 miles. Track laid in 1889, 45 miles. In process of construction, 55 miles. Projects of some promise, 405 miles.

WASHINGTON.—Existing Roads.

9. ***Ellensburg & Northeastern.***—Under construction, Ellensburg northeast, 10 miles. Surveyed, 10 mile post to Port Easton, 30 miles. President, John C. Snoody; secretary, V. C. Lloyd; both of Ellensburg.

10. ***Fairhaven & Southern.***—Track laid in 1889, Fairhaven to Alger, 15 miles. Under construction, Alger to Sedro, 11 miles; Fairhaven to New Westminster, B. C. 48 miles. Surveyed, Sedro to silver mines, 70 miles. Projected, Sedro to Oregon State line, 200 miles. President, Nelson Bennett, Tacoma; Chief Engineer, J. J. Donovan, Fairhaven; Vice-President, E. M. Wilson, Tacoma.

11. ***Hiram Steam Navigation.***—Track laid in 1888, Hwaco to Long Beach, 4 miles. Track laid in 1889, Long Beach to Naselle, 12 miles. Chief Engineer, F. E. Habersham, Portland, Ore.

12. ***Mason County Central.***—Track laid in 1889, Shelton southwest, 3 miles. Projected, end of track to Chehalis River, 6 miles. Chief Engineer, Wm. Kneeland, Shelton.

4. ***Northern Pacific.***—Track laid in 1888, near Colton to Genesee, Idaho, 15.6 miles; Orting to Lake Kapoosin, 7 miles; Palmer to Durham, 2.9 miles; Orting to Carbonado, 5.5 miles; Pasco to Kennewick, 3.3 miles; Cheney to end of track, 17.7 miles. Track laid in 1889, near Hite to Almira, 67 miles; end of track south of Ortine to Puyallup River, 3.8 miles. Under construction, Almira to Grand Coulee, 15 miles. Projected, Grand Coulee to Cheyenne, 80 miles.

13. ***Oregon & Washington Territory.***—Track laid in 1888, Hunt's Junction to Eureka Flat, 42 miles; Eureka Junction to Walla Walla, 30 miles. Track laid in 1889, Walla Walla toward Dayton, 25 miles. Graded, end of track to Dayton, 9 miles. Located, Eureka Flat to Snake River, 13 miles. Under survey, Walla Walla to Union, Ore., 120 miles. Chief Engineer, F. Riffle, Walla Walla.

14. ***Oregon Ry. & Navigation Co.***—Track laid in 1888, Riparia to La Crosse Junction, 24.6 miles; Farmington to Rockford, 35.9 miles; Steptoe Junction west, 10 miles; Winona Junction east 2 miles. Track laid in 1889, Palouse River to Oakesdale, 37.1 miles; Rockford to Spokane Falls, 27.1 miles; Tekoa east, 60 miles. Under construction, end of track to Mullan, Idaho, 27 miles.

15. ***Port Townsend Southern.***—Under construction, Port Townsend south, 30 miles. Surveyed, 30-mile-post to Northern Pacific R. R., 90 miles. Chief Engineer, J. B. Hogg, Port Townsend.

16. ***Puget Sound & Gray's Harbor.***—Track laid in 1889, Summit to Montesano, 20 miles. Chief Engineer, Ira C. Otis, Montesano.

17. ***Seattle, Lake Shore & Eastern.***—Track laid in 1888, Seattle east, 27 miles; Spokane Falls west, 45 miles; Snohomish Junction north, 20 miles. Track laid in 1889, Falls City southeast, 10 miles. Under construction, Snohomish to Mission Station, B. C., 32.5 miles. Surveyed, point 45 miles west of Spokane Falls to Columbia River, 120 miles. Projected, Columbia River to Snohomish, 100 miles; main line to Davenport, 5 miles.

18. ***Spokane Falls & Northern.***—Track laid in 1889 Spokane Falls to Colville, 88 miles. Under construction, Colville to Little Dalles, 40 miles. Under survey, Little Dalles to Kootenai, B. C., 100 miles. D. C. Corbin, Spokane Falls.

19. ***Tacoma & Fern Hill.***—Track laid in 1888, Tacoma to Oakesdale, 3 miles. Track laid in 1889 Oakesdale to Hosmer's, 1 mile. Superintendent, J. O. Brown, Tacoma.

20. ***Vancouver, Klickitat & Yakima.***—Track laid in 1888, Vancouver toward Salmon Creek, 5 miles. Track laid in 1889, end of 1888 track to Salmon Creek, 6 miles. Under survey, Salmon Creek to North Yakima, 165 miles.

Projects and Surveys.

21. ***Pasco, Goldendale & Eastern.***—Projected, Goldendale to Pasco, 105 miles. President, R. O. Dunbar, Goldendale; Chief Engineer R. A. Hatersmam, Portland, Ore.

22. ***Seattle & Southern.***—Surveyed, Seattle to Portland, Ore., 160 miles. Vice-President, L. S. J. Hunt, Seattle.

23. ***Tacoma & Puyallup.***—Projected, Tacoma to Puyallup, 13 miles. Frank O. Wecker Tacoma.

24. ***Tacoma & Silver Beach.***—Surveyed, Tacoma to Steilacoom, 9 miles. President, E. E. Bair; Chief Engineer, L. C. Vickery, both of Tacoma.

Total.—Track laid in 1888, 291 miles. Track laid in 1889, 330 miles. In process of construction, 2.3 miles. Under survey, 677 miles. Projects of some promise, 500 miles.

ALBERTA and BRITISH COLUMBIA.

(See Washington and Montana.)

Total.—In process of construction, 40 miles. Under survey, 100 miles. Projects of some promise, 85 miles.

OREGON.—Existing Roads.

25. ***Astoria & South Coast.***—Track laid in 1889, Astoria south, 2 miles. Under construction, end of track to Tillamook, 16 miles. Under survey, Tillamook to Jewell, 24 miles. Chief Engineer, Henry B. Thielsen, Astoria.

13. ***Oregon & Washington Territory.***—Track laid in 1888, Stanton to Fulton; 14 miles; Stanton to Centerville, 15 miles. Located, Fulton to Butter Creek, 30 miles.

26. ***Oregon Pacific.***—Track laid in 1888, 20 miles east of Albany east, 35 miles. Under construction, end of track east, 50 miles. Projected end of grade to Boise City, Idaho, 170 miles.

14. ***Oregon Ry. & Navigation Co.***—Track laid in 1888 Willows Junction to Heppner, 45.5 miles. Projected, La Grande to Willows, 35 miles.

27. ***Portland & Vancouver.***—Track laid in 1888, East Portland to Vancouver, 6.5 miles.

Portland & Willamette Valley.—Track laid in 1888, in Portland 0.4 miles; Dundee Junction to Fulquartz, 1.3 miles.

Projects and Surveys.

28. ***Portland, Mt. Hood & Eastern.***—Projected, Portland to Mt. Hood, 70 miles. President R. P. Earhart; General Manager, W. A. Bantz; both of Portland.

29. ***Salem, Tillamook & Astoria.***—Projected, Salem to Astoria, 130 miles. John W. Wright; J. A. Manning, both of Salem.

30. ***Siuslaw & Eastern.***—Surveyed, Eugene to Florence, 50 miles. President, A. G. Hovey; Chief Engineer, Alfred Kirkland; both of Eugene.

Total.—Track laid in 1888, 118 miles. Track laid in 1889, 2 miles. In process of construction, 66 miles. Under survey, 204 miles. Projects of some promise, 545 miles.

CALIFORNIA.—Existing Roads.

31. ***Alameda County Terminal.***—Surveyed, San Leandro to Castro Valley, 15 miles.

32. ***Anaheim, Olinda & Pomona.***—Partly graded, Almitos Bay to Pomona, 35 miles. President, Edw. Records, Los Angeles; Chief Engineer, S. O. Wood, Anaheim.

33. ***Atchison, Topeka & Santa Fé.***—Track laid in 1888, 69 miles west of San Bernardino to Mentone, 5.6 miles; Perris to San Jacinto, 19.48 miles; Inglewood to Redondo Beach, 10.8 miles; Baliona Junction to Orange, 29.5 miles; San Juan to 1 mile north of Los Angeles Junction, 22.7 miles.

34 ***Atlantic & Pacific.***—Under construction, point in Arizona Territory to point in California, 13 miles. (This is only a change of line to carry the railway across the new Colorado River Bridge.)

35. ***California & Nevada.***—Under construction, San Pablo east, 5 miles.

36 ***Carson & Colorado.***—Projected, Keeler to Mojave, 110 miles.

37. ***Chino Valley.***—Track laid in 1888, Ontario to Harrington Station, 10 miles. Projected, Harrington to Newport 35 miles. President, Richard Gird; Chief Engineer, H. B. Martin; both of Chino.

38. ***Los Angeles & Pacific.***—Track laid in 1888, Kenneiworth to Burbank, 4 miles; Junction to Santa Monica, 15 miles.

39. ***Los Angeles, Pasadena & Glendale.***—Under contract, Los Angeles to Pasadena, 7 miles. President, John Cruse, 27 West Second St., Los Angeles.

40. ***Los Angeles, San Diego & Yuma.***—Track laid in 1889, in San Diego, 8 miles. Projected, San Diego to Los Angeles, 110 miles; San Diego to Yuma, Ariz., 142 miles. President, Wm. Graves; Chief Engineer, O. N. Sanford; both of San Diego.

41. ***Marysville, Sutter City & Colusa.***—Under construction, Marysville to Colusa, 30 miles. President, Alex. Badlam, San Francisco.

42. ***Nevada, California & Oregon.***—Track laid in 1888, 43 mile post to 70 mile post, 27 miles. Under construction, Liegan to Madeline Plain, 53 miles. Projected, Madeline Plain to Alturas, 55 miles.

43. ***North Pacific Coast.***—Projected, main line to Bolinas, 15 miles.

44. ***Redondo.***—Track laid in 1889, Los Angeles to Redondo Beach, 17 miles. Under construction, in Los Angeles, 3 miles. President, Geo. J. Ainsworth; Chief Engineer, L. Frisi; Vice President, S. O. Brown; all of Los Angeles.

45. ***San Diego, Cuyamaca & Eastern.***—Track laid in 1889, San Diego to Lakeside, 22 miles. Under construction, Lakeside to Foster's, 3 miles. Projected, Foster's to San Felipe Pass, 85 miles. President, H. W. Waterman Auditor, G. D. Waterman; Chief Engineer, B. R. Whitney; all of San Diego.

46. ***San Diego, National City & Otay.***—Track laid in 1888, Sweetwater Dam to La Presa, 2.04 miles; Tia Juana Junction to Tia Juana, 4.45 miles.

47. ***San Diego, Oldtown & Pacific Beach.***—Track laid in 1888 San Diego to Pacific Beach, 11 miles.

48. ***San Francisco & North Pacific.***—Track laid in 1888, Cloverdale to Hopland, 14 miles.

49. ***San Francisco & San Joaquin Valley.***—Partly graded, in San Joaquin Valley, 80 miles. President, J. B. Wilbur, San Francisco.

50. ***San Pedro, Los Angeles & Utah.***—Track laid in 1888, Raymond to Altadena, 7 miles.

51. ***Santa Ana, Fairview & Pacific.***—Track laid in 1888, Santa Ana to Fairview, 7.5 miles. Under survey, Fairview to Newport Wharf, 4.5 miles. A. L. Clark, Fairview.

52. ***Southern Pacific.***—Track laid in 1888, Shingle Springs to Placerville, 11.6 miles; Willows to Fruto, 16. miles; Templeton to Santa Margarita, 7.75 miles; Marysville to Yuba City, 1.5 miles; Napa River to Santa Rosa 33.6 miles; Huron to Alcalde, 20.6 miles; Fresno to Poso, 95.3 miles; San Pedro to Outer Harbor, 2.9 miles; Studebaker to Whittier, 5.9 miles; Anaheim to Tustin, 11.7 miles; Madison to Rumsey, 24 miles. Track laid in 1889, Near Palomas to Santa Margarita, 3.95 miles; Monterey to Lake Mejlia, 4.43 miles; Newman to Los Banos, 21.39 miles. Under construction, Knight's Landing to Yuba City, 26.2 miles. Surveyed, Santa Margarita to Elwood, 75 miles. Projected, Los Banos, south, 130 miles; Oakdale to Sanger, 100 miles; Bakersfield to San Miguel, 100 miles.

3. ***Union Pacific.***—Under survey, Los Angeles to Frisco, Utah, 450 miles. Projected, Riverside, Ore., to Oroville, Cal., 450 miles.

53. ***Visalia & Tulare.***—Track laid in 1888, Visalia to Tulare, 11.5 miles.

54. ***Yreka Branch.***—Track laid in 1888, Montague to Yreka, 7.5 miles.

Projects and Surveys.

55. ***Los Angeles & Eastern.***—Located, Los Angeles to Kramer, 95 miles. President, T. J. Cuddy; Chief Engineer, T. J. Rix; both at 25 No. Main St., Los Angeles.

56. ***Los Angeles & Hueneme.***—Projected, Los Angeles to Hueneme, 60 miles. W. S. Hughes, Los Angeles; Thos. R. Bard, Hueneme.

57. ***Pacific.***—Projected, Colima to Santa Cruz, 45 miles. Chief Engineer, F. C. Newcomb, San Francisco.

58. ***Point Arena.***—Surveyed, Point Arena to Garcia River, 10.5 miles. Chief Engineer, Julius H. Smith San Francisco; Proprietors, Wells, Russell & Co., San Francisco.

59. ***San Bernardino Central.***—Projected, San Bernardino to South Riverside, 30 miles. President, J. C. Monteith, San Diego.

60. ***Santa Ana & Long Beach.***—Surveyed Santa Ana to Long Beach, 20 miles. President, M. J. Bundy, Santa Ana; Chief Engineer, Capt. Healy, Long Beach.

61. ***Stockton, Fresno & Southern.***—Surveyed, Stockton to Visalia, 175 miles. President, Henry S. Davis, 212 Sansom St., San Francisco; Chief Engineer, E. E. Tucker, Stockton.

Total.—Track laid in 1888, 441 miles. Track laid in 1889, 77 miles. In process of construction, 234 miles. Under survey, 625 miles. Projects of some promise, 1,267 miles.

NEVADA.—Existing Roads.

62. ***Nevada Central.***—Projected, Battle Mountain to Butte, Mont., 600 miles.

Total.—Under survey, 175 miles. Projects of some promise, 210 miles.

UTAH.—Existing Roads.

63. ***Ogden & Hot Springs.***—Under construction, Ogden to Hot Springs, 15 miles. Col. A. H. Swan, Ogden.

64. ***Salt Lake & Eastern.***—Track laid in 1888, Salt Lake City toward Park City, 15 miles. Track laid in 1889, sheet ore beds to Park City, 16 miles. Under survey, Park City to timber belt, 25 miles. Secretary, D. Harrington, Salt Lake City.

Salt Lake & Fort Douglas.—Track laid in 1888, belt line at Salt Lake City, 20 miles.

65. ***San Pete Valley.***—Projected, Chester to Manti, 15 miles.

66. ***Wyoming, Salt Lake & California.***—Under construction, Evanston to Lake Point, 125 miles.

Total.—Track laid in 1888, 35 miles. Track laid in 1889, 16 miles. In process of construction, 140 miles. Under survey, 375 miles. Projects of some promise, 15 miles.

COLORADO.—Existing Roads.

67. ***Burlington & Missouri River.***—Projected, St. Frances, Kan., to Colorado Springs 180 miles.

68. ***Chicago, Rock Island & Pacific.***—Track laid in 1888, Kanorado to Colorado Springs, 108.3 miles.

69. ***Colorado Midland.***—Track laid in 1888, Glenwood to Newcastle, 12.6 miles.

70. ***Denver & Rio Grande.***—Track laid in 1888, Petersburg to Minnery Post, 2.3 miles. Track laid in 1889, Sapinero to Lake City, 36 miles; Glenwood Springs to Rifle Creek, 25.41 miles; Ridgeway to Aberdeen, 5 miles. Under construction, Rifle Creek to Grand Junction, 64 miles; Manitou to Pike's Peak, 9 miles. Projected, Villa Grove to Monte Vista, 50 miles; Denver to Salida, 110 miles.

71. ***Denver, Texas & Fort Worth.***—Track laid in 1888, end of track to New Mexico line, 19 miles. Track laid in 1889, Forbes' Junction to Victor mines, 7.5 miles.

72. ***Silverton.***—Track laid in 1888, Burro Bridge to end of track, 9 miles. Track laid in 1889, end of 1888 track to Ironton, 3.75 miles. Under construction, Silverton to Eureka, 9 miles. Projected, Eureka to Lake City, 50 miles.

Projects and Surveys.

73. ***Aspen-Ashcroft.***—Projected, Aspen to Ashcroft, 13 miles. President, H. A. W. Tabor; Chief Engineer, C. E. Schriver; Vice-President, Ira W. Pendleton; all of Denver.

74. ***Denver, Colorado Canon & Pacific.***—Surveyed, Grand Junction to Marble Cañon, 300 miles. Projected, Marble Cañon to The Needles, 300 miles. President, H. B. Chamberlain, Colorado Springs; Chief Engineer, Robert B. Stanton.

75. ***Elk Mountain.***—Surveyed, Carbondale to Crystal, 23 miles. President, Orlando Metcalf; Chief Engineer, Thos. Wigglesworth; both of Colorado Springs.

76. ***Georgetown, Silver Creek & Chicago Lakes.***—Projected, Georgetown to mines, 10 miles. President, W. H. Hamilton Georgetown.

77. ***Golden & Denver.***—Located, Golden to Denver, 22.75 miles. President, John C. Hodges, Jr.; Chief Engineer, Edw. L. Berthoud, Golden.

78. ***La Jara, Pagosa Springs & Western.***—Surveyed, La Jara to Pagosa Springs, 90 miles. President,

J. W. Schiffer; Chief Engineer, R. R. Salter; both of La Jara.

79. ***Little Book Cliff.***—Surveyed, Grand Junction to Little Book Cliff, 11 miles. President, W. T. Carpenter, Grand Junction; Chief Engineer, E. B. Sawyer, Montrose.

80. ***Pueblo & Western.***—Under survey, Pueblo to Rosita, 55 miles. President, J. C. Teller, Denver; W. F. Townsend, Pueblo.

81. ***Rio Grande Southern.***—Projected, Dallas to Durango, 160 miles. President, Otto Mears, Silverton.

82. ***San Juan & Southern.***—Projected, Dallas to Rico, 60 miles. President, David Wood, San Juan; Vice-President, T. B. Townsend, Montrose.

Total.—Track laid in 1888, 211 miles. Track laid in 1889, 79 miles. In process of construction, 82 miles. Under survey, 227 miles. Projects of some promise, 618 miles.

NEW MEXICO.—Existing Roads.

Denver, Texas & Fort Worth.—Track laid in 1888, Colorado State line to Texas State line, 81 miles.

83. ***Santa Fé Southern.***—Surveyed Santa Fé to San Pedro, 49 miles.

84. ***Silver City, Pinos Altos & Mongallon.***—Under construction, Silver City east, 10 miles.

85. ***Sonora, Sinaloa & Chihuahua.***—Track laid in 1889, Chihuahua, Mex., west, 4 miles. Graded, Deming, N. M., to International boundary, 30 miles; Guaymas, Mex., east, 30 miles. Surveyed, International boundary south 120 miles; end of grade from Guaymas east, 120 miles. Projected, in Mexican States of Sonora and Chihuahua, about 300 miles. President, Geo. H. Sisson, New York; Chief Engineer, Chas. Scofield, Deming, N. M; Contractors, Elliot, Huss & Co., Deming and Chicago, Ill.

Total.—Track laid in 1888, 81 miles. In process of construction, 40 miles. Under survey, 250 miles. Projects of some promise, 210 miles.

ARIZONA.—Existing Roads.

86. ***Arizona & Southeastern.***—Track laid in 1888. Fairbank to Bisbee, 36 2 miles.

87. ***Arizona Mineral Belt.***—Projected Fulton to Globe, 144 miles.

Projects and Surveys.

88. ***Phœnix & Prescott.***—Projected, Phœnix to Prescott 140 miles. Chief Engineer, A. McGinnis, Phœnix.

Total.—Track laid in 1888, 36.2 miles. In process of construction, 4 miles. Under survey, 50 miles. Projects of some promise, 484 miles.

TEXAS.—Existing Roads.

Atchison, Topeka & Santa Fé.—Track laid in 1888, end of track to Panhandle City, 4.5 miles.—Gulf, Colorado & Santa Fé.—Ballinger to San Angelo, 35 miles.

89. ***Austin & Northwestern.***—Track laid in 1889, Burnet to Marble Falls, 16 miles. Projected, Marble Falls to Llano, 15 miles.

90. ***Dallas, Pacific & Southeastern.***—Under construction, Dallas to Graham; 110 miles. Projected, Graham to Albuquerque, N. M., 390 miles.

Denison & Washita Valley.—Track laid in 1889, from Lehigh, Ind. Ter., to Colgate, 9 miles. Under construction, Lehigh to Denison, Tex., 55 miles. Projected, Colgate to Fort Smith Ark., 125 miles.

Denison, Bonham & New Orleans.—Partly graded, Denison to Bonham, 45 miles. President, R. B. Allen, Bonham; Chief Engineer, Fred P. James, Denison.

Denison Rapid Transit.—Track laid in 1889, at Denison, 6.5 miles. Engineers, Filley & Co., Kansas City, Mo.

Fort Worth & Denver City.—Track laid in 1888, Washburn to Panhandle City, 16 miles.

91. ***Fort Worth & Rio Grande.***—Track laid in 1889, Granbury south, 40 miles. Under construction, end of track to Dublin, 10 miles. Under survey, Dublin to Comanche, 22 miles. Contractors, Hurley, Tierney & Lynch, Fort Worth. Chief Engineer, E. Miller, Granbury.

92. ***Kansas City, El Paso & Mexican.***—Track laid in 1888, El Paso to Lamoria, 10 miles.

Kildare & Linden.—Track laid in 1888, Kildare to Linden, 14 miles.

93. ***Missouri, Kansas & Texas.***—Track laid in 1888, Dallas to Lancaster, 16 miles. Track laid in 1889, Lancaster to Waxahatchie, 13 miles.

Paris, Marshall & Sabine Pass.—Under construction, Starr's to Paris, 100 miles.

94. ***Red River, Sabine & Western.***—Under construction, San Augustine, to Palestine, 110 miles. Projected, Palestine to Fort Worth, 130 miles; San Augustine to Alexandria, La., 105 miles. President Li. W. Lloyd, Chief Engineer; J. C. Tarry, both of Nacogdoches.

95. ***Rio Grande & Eagle Pass.***—Projected, Santa Tomas toward Eagle Pass, 25 miles.

96. ***St. Louis, Arkansas & Texas.***—Track laid in 1888, Remer to Fort Worth, 41 miles.

97. ***San Antonio & Aransas Pass.***—Track laid in 1888, Gregory to Rockport, 20 miles; Skidmore to Kleberg, 43 miles; Houston west, 35 miles. Track laid in 1889, Brazos river east, 10 miles; Shiner to Lockhart, 55.5 miles. Under construction, Guadalayuse to Llano, 74 miles; West Point to Waco, 120 miles. Located, Houston to Trinity River, 44 miles. Projected, Trinity River to Alexandria, La., 181 miles. Under survey, Kennedy to Laredo, 150 miles.

52. ***Southern Pacific.***—Track laid in 1889, Victoria to Beeville, 55 miles.

99. ***Texas & Pacific.***—Track laid in 1888, Gordon to Gordon Mines, 3 miles.

Texas, Sabine Valley & Northwestern.—Track laid in 1888, Mineral Springs to Carthage, 14 miles.

99½. ***Weatherford, Mineral Wells & Northwestern.***—Under construction, Weatherford to Mineral Wells, 30 miles.

Projects and Surveys.

100. ***Brazos Terminal.***—Surveyed, Velasco to Arcola, 40 miles. President, Wm. D. Lee, Leavenworth, Kan.

101. ***Cattle Trail.***—Surveyed Red River to Brady, 240 miles. Projected, Brady to Eagle Pass, 225 miles. Chief Engineer, Stanly M. Jones, Baird.

102. ***Fort Worth & Albuquerque.***—Surveyed, Ft. Worth to Albuquerque, N. M., 500 miles. Chief Engineer, Stephen D. Temple, Chicago.

103. ***Houston Belt & Magnolia Park.***—Under survey Houston to Port Houston, 4 miles. W. D. Cleveland, Houston.

104. ***Lampasas, Burnet & Southwestern.***—Surveyed Lampasas to Burnet, 23 miles. Chief Engineer, H. L. Higdon, Lampasas.

Sulphur Springs & Red River.—Projected Sulphur Springs to Red River, 60 miles. Geo. B. Boomer, Sulphur Springs.

105. ***Texas Midland.***—Projected, Waco to Shreveport, La., 243 miles. President, W. A. Taylor; Chief Engineer, Stephen Turner; both of Waco.

MEXICO.—Existing Roads.

Chihuahua & Cusihuiriachic.—Under construction, Chihuahua to Cusihuiriachic, 50 miles.

Interoceanic.—Track laid in 1889, Vireyes to Perote, 35 miles. Under construction, Yautipec to Amacuzac, 30 miles; Perote to Vera Cruz, 125 miles. Projected, Amacuzac to Acapulco, 150 miles.

Mexican Central.—Track laid in 1888, mile post-66 to Guadalajara, 95 miles; mile-post-373 north from city of Mexico, to Salinas, 6.4 miles; mile-post-105 on Tampico, Division, 10.4 miles. Track laid in 1889, Salinas to San Luis Potosi, 7.1 miles. Under construction, San Luis Potosi to La Garita, 147 miles; Guadalajara to 16 miles east of San Blas, 150 miles.

Mexican National.—Track laid in 1888, Encantado to Chirimoya, 274 miles; San Miguel to Chirimoya, 60 miles. Track laid in 1889, Venegas to Cedral, 18 miles. Under construction, Cedral to Matehuala, 20 miles.

Mexican Southern.—Under construction, Puebio to Tecumavaca, 130 miles. Projected, Tecumavaca to Oaxaca, 110 miles. Jas. Livesey & Sons, London, Eng.

Monterey & Mexican Gulf.—Track laid in 1889, Monterey south, 78.2 miles. Under construction, Monterey to Venadito, 67 miles; end of track south of Monterey to Tampico, 350 miles. President, Gen. Geronimo Trevino; Chief Engineer, Wm. H. Wentworth, Monterey.

Tehuantepec.—Under construction, between ends of track, 207 miles.

Projects and Surveys.

Matamoras & Matehuala.—Projected, Matamoras to Matehuala, 275 miles. President, Gen. Pedro Martinez, city of Mexico.

Mexican Pacific.—Projected, Hermosillo to Mazatlau, 800 miles. E. A. Warner, City of Mexico.

Peninsular.—Projected, Merida to Campeche, 100 miles.

Zacualtipan.—Projected, Pachuca to Tampico, 175 miles.

Total.—Track laid in 1888, 505.8 miles. Track laid in 1889, 206.2 miles. In process of construction, 1,315 miles. Under survey, 340 miles. Projects of some promise, 1,910 miles.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York, Lake Erie & Western.—The annual statement of this company for the year ending Sept. 30, 1889, shows the following results from operation:

	1888.	1889.
Gross earnings	$24,832,819	$24,595,273
Operating expenses	18,003,469	17,854,424
Net earnings	6,829,350	6,740,849

Waynesburg & Washington.—This road, will it is stated, be extended from Waynesburg, Pa., to Blacksville, W. Va.

Old Colony.—At a meeting of the stockholders held Nov. 26, it was voted to increase the capital stock of this company to $15,000,000. The increase is to provide means for new extensions and other permanent improvements. These are to be paid for both by the proceeds of the bonds and stock, and the stock will be sold in the open market. It was also voted to authorize the Directors to issue bonds to an amount not exceeding $1,000,000 to provide for the building of local branches.

Maine Central.—The annual statement of this company for the year ending Sept. 30, 1889, shows the following results from operations:

Gross earnings	$3,828,261
Operating expenses and taxes	2,514,715
Net earnings	$1,313,446

The President in his preliminary statement says: During the past year 34 miles of road have been constructed; the extension of the Portland & Ogdensburg Division from Fayban's to Scott's Mills, 17 miles and from Dexter to Dover and Foxcroft, 17 miles. The latter road was built by the Dexter & Piscataquis R. R. Co. and a lease was taken by this company at $12,500 per annum. Other important extensions are under consideration, construction of which it is hoped will commence next year.

Kinderhook & Hudson.—Tracklaying has been commenced on this road which is to run from Hudson to Kinderhook, N. Y., 16.25 miles. E. G. FERRIS, of Hudson, is Chief Engineer.

Chicago & West Michigan.—The engineers of this company have commenced the survey for the line from Traverse City to Elk Rapids, Mich.

Delaware & Hudson Canal Co.—This company is considering building a marine railway from Lake Champlain to Lake George, in New York.

Canadian Pacific.—Tracklaying on the Ontario & Quebec Ry. is nearly completed and it is stated that the line will be in operation from London to Windsor, Ont. next month.

Pennsylvania.—Contracts are reported let for the extension from Radebaugh, Pa., to a point 3 miles above Arona, Pa., a distance of 9 miles. Chas. King, of Schuylkill County, Pa., is the contractor.—The company has submitted plans for the elevated road through New Brunswick, N. J., to the City Council of that place. The road now crosses the streets at grade. The change will necessitate the erection of a new bridge over the Raritan River and of a new station to replace the George Street depot.

Central Michigan.—A meeting of the stockholders will be held Dec. 16, for the election of a Board of Directors and also to vote upon the question of amending the company's Articles of Association to permit of a change in said company's line or route of railway, and the building of two or more branch lines of railway to its main line of road. According to the present articles the road is to run from Rogers City, Mich., to Garrett, Ind., 335 miles, with branches from Greenville to Alger, Mich., 100 miles, and from Lowell to Grand Rapids, 18 miles. The road is now completed and in operation from Lowell to Hastings, Mich., 20 miles. J. W. BOYNTON, of Grand Rapids, Mich., is President.

Michigan Central.—It is announced that this company will build a line from St. Clair and Marine City to Detroit, Mich.

New York, Ontario & Western.—This company has a party of engineers at work making surveys for a projected extension of the Delhi branch to Bloomville, N. Y., 15 miles, there to connect with the Delaware & Otsego branch of the Ulster & Delaware railroad.

Confluence & Oakland.—It is announced that work will soon begin on the extension of this road from Friendsville, Md., up the Big Youghiogheny River to Yough Manor where the company owns valuable coal lands.

Projects and Surveys.

Evansville, Newburg & Rockport,—Incorporated in Indiana to build a railway from Newburg, Warrick County, to Rockport, Spencer County, a distance of 25 miles. This road is a dummy line, and is but the beginning of a system of suburban railways which will connect all the small towns within a radius of 50 miles with Evansville, Ind. The new extension will, it is understood, be in operation by July. The incorporators are: W. J WOOD, LU HOWELL, D. J. MACKEY, F. W. COOK, WM HELLMAN and others.

Deshler, Napoleon & Northwestern,—This company has been incorporated in Ohio to build a railway from Deshler to Napoleon, a distance of about 25 miles.

Waterloo Junction.—J. C. BAILEY, Chief Engineer, has just completed the locating surveys for this road from Elmira to Waterloo, N. Y. A preliminary line has also been run from Elmira to Drayton.

SOUTHERN.—Existing Roads.

Richmond, Fredericksburg & Potomac,—At the annual meeting of this company recently held, a resolution was adopted authorizing the President and Board of Directors to prepare and issue bonds to the amount of $2,500,000 for the purpose of providing for all obligations and indebtedness of the company, and for the purchase of additional equipment, for double tracking the road, for the construction of branches and extensions that may be deemed necessary, and for other purposes.

Atlantic Coast Line,—The contract for building the 28 mile extension from Greenville to Kinston, N. C. has been awarded to O'Hearn Bros.

Jacksonville Tampa & Key West.—It is reported that this company will build a line from De Land to Beresford, Fla.

Alabama Midland,—Tracklaying on this road has reached Brundidge, Ala., about 30 miles northwest of Ozark.

Georgia Southern & Florida,—Surveys are reported in progress for a branch from Tifton to Thomasville, Ga., about 55 miles.

East Tennessee, Virginia & Georgia,—The annual statement of this company for the year ending June 30, 1889 shows the following earnings and expenses:

Gross earnings	$5,301,024
Operating expenses	3,374,065
Net earnings	1,926,959

Richmond & Chesapeake,—Chief Engineer OLIVER W. BARNES, of this city, writes to correct the item in regard to this company, in our issue of Nov. 16, p. 476. The item was by mistake headed "Richmond, Fredericksburg & Potomac." Mr. BARNES says:

The proposed Richmond & Chesapeake Railroad is a newly chartered company authorized to build a line of railroad from the city of Richmond to Chesapeake Bay and the Potomac River. It has also a franchise authorizing it to construct a tunnel under Eighth St. in the city of Richmond, to make a short connection through that city, with the lines entering the Union Depot on the south side of the city, and with the Chesapeake & Ohio, and other railroads on the north side of the city. This tunnel is now in progress of construction. The line of road to be constructed from Richmond to the Potomac, will, by ferry across the Potomac, connect with an extension of the Baltimore & Drum Point R. R., and thereby make a through line from Richmond to Baltimore, about 150 miles in length. At the city of Baltimore it will connect with the Baltimore & Ohio R. R., and its Philadelphia Division. The enterprise is entirely independent of the Richmond, Fredericksburg & Potomac R. R.

Projects and Surveys.

Abbeville & Way Cross.—J. D. MAYNARD, of Abbeville, Ga., President, sends us the following data concerning this enterprise:

The road is to run from Abbeville, via Douglassville to Way Cross, Ga., a distance of about 85 miles. The route is through a yellow-pine forest, the entire distance, and affords very easy grades and curves. The principal business of the road will be in lumber and turpentine. All of the right of way has been secured and other local aid sufficient to grade the road bed, and furnish the crossties, has been obtained. The final locating surveys will begin about Jan. 1. It is expected that contracts will be let about January or February. Tracklaying will commence in February.

Mount Sterling.—A correspondent writes us that no company has been formed to build this road. The Mount Sterling Commercial Club has engaged a corps of engineers to make surveys from Mount Sterling to Clay Springs, Ky., from Mount Sterling to Indian Springs, Ky. and from Mount Sterling to North Middletown, Ky., Those surveys are being made with a view to getting

some railway company to build the proposed lines. If not successful in this, the Legislature will be asked for a charter to enable the county to build them.

Bluefield & Hinton.—C. H. DURING, of Bramwell, W. Va., writes us as follows:

This company was organized some time ago to build a railway from Bluefield to Hinton, W. Va., making connections north and south between the Norfolk & Western system and the Chesapeake & Ohio R. R. The matter was placed before the county through which the road would run, asking for a subscription of $30,000 in aid of the enterprise. A vote was taken resulting in the refusal of this aid by the county. It is not known whether the project will be revived or not.

Luray & Washington.—A press dispatch from Luray, Va., states that an engineering corps with headquarters at that place is making surveys for a railway from Luray to Washington, Va.

West Virginia & Pennsylvania. — It is announced that contracts for the construction of this road have been let. The road is projected to run from Rowlesburg, W. Va., to either Uniontown or Fairchance, Pa. C. C. GALLAGHER, of Rowlesburg, is interested.

Birmingham & Shale Mountain.—Chartered in Alabama to build a line of railway from Hails Spring via Grace's Gap to Birmingham, Ala., about 8 miles.

Manatee & Sarasota.—Incorporated in Florida to build a railway from a point on the Manatee River to Sarasota, 20 miles. The incorporators are: W. C. PATTEN, Braidentown, Fla.; J. HAMILTON GILLESPIE, Sarasota, Fla.; JOSEPH VOYLE, Gainesville, Fla.; HENRY N. SHEPARD, Boston, Mass.; and J. H. HUMPHRIES, Braidentown, Fla.

NORTHWEST.—Existing Roads.

Milwaukee & Northern.—Surveys have been commenced for a line from Iron Mountain to Sidnaw, Mich., a distance of about 70 miles.——It is stated that this company has purchased the Oconto & Southwestern R. R. running from Oconto, Wis., to a connection with its main line, a distance of 14¼ miles.

Jacksonville Southeastern.—A press dispatch states that this company is rapidly pushing its St. Louis extension to completion. It has already completed the line to the Mt. Olive coal district.

Baltimore & Ohio.—A report is in circulation that this company is about to extend its line from Beardstown, Ill., to Fort Madison, Ia., where connection will be made with the Atchison, Topeka & Santa Fé R. R.

Des Moines & Northern.—This company has been incorporated in Iowa. The company is a reorganization of the St. Louis, Des Moines & Northern R. R. Co., which operates a narrow gauge road from Des Moines to Boone, Ia., 50 miles. It is stated that the new company will widen the gauge of the road, and extend it to the Minnesota State line.

Milwaukee, Menominee Falls & Western. — W. POWRIE, of Templeton, Wis., Chief Engineer writes us that 3 miles of track have been laid on this road. The 193-ft. trestle across the Menominee River is completed. It is expected that the entire line from Granville to Sussex, Wis., 10 miles, will be completed by Jan. 1, 1890.

Projects and Surveys.

Niobrara & Sioux Reservation.—The city of Niobrara, Neb., has voted $8,000 in aid of this road. The road is projected to run from a point in Airtrope County through Knox County to the State line.

Calgary & Edmonton.—This company has applied to the Dominion Parliament for a charter to build a railway from Calgary, Alberta, to Edmonton, with extensions south to the International boundary, and north to the Pense River.

SOUTHWEST.—Existing Roads.

San Antonio & Aransas Pass.—Grading on the extension to Waco is making rapid progress, and it is thought that the line will be completed by Jan. 1, 1890, as called for by the contract.

Missouri Pacific.—Work is reported to have been commenced on the Fort Scott & Eastern R. R., which is projected to run from Fort Scott, Kan., to Tipton, Mo., 130 miles.

Chicago, Rock Island & Pacific.—Construction is in progress on the extension of the line from Kingfisher south to El Reno, Indian Territory, 25 miles. It is expected to have the line in operation to El Reno by Jan. 1890.

Projects and Surveys.

Kansas City Union Depot Bridge & Terminal Co.—Articles of incorporation have been filed with the Secretary of State, of Missouri, by the Union Depot Bridge Railway and Railway Terminal Co., of Kansas City, Mo., and Kansas City, Kan.; capital stock, $12,000,000. The object is to provide depot and bridge facilities for the railroads centering at Kansas City. The Directors are HENRY MCGRAW, WM. P. VANAKAN, NICHOLAS MCALPINE, Kansas City, Kan.; WM. H. REED, ROBERT M. RAY, Kansas City, Mo.

ROCKY MT. AND PACIFIC.—Existing Roads.

St. Paul, Minneapolis & Manitoba.—Work on the extension of the Sand Coulee branch of the Montana Central R. R. to the Belt Mountains is progressing rapidly. It is expected to have the ear.hwork completed in about a month. The rock work will be carried on all winter and the line completed early next spring.

Salt Lake & Eastern.—Surveys are reported in progress for the extension of this road down the Duchesne River to the Green River and thence up the White River into Colorado. The road is now completed from Salt Lake City to Park City, Utah.

Santa Fé Southern. — It is stated that arrangements have been made for beginning the construction of the line from Santa Fé to San Pedro, N. M., 49 miles, soon. The surveys have been completed and maps and profiles are now being made.

Oregon Ry. Navigation Co.—It is announced that work will soon begin on the branch from La Grande, Ore., to Wallowa. The line will open up a rich farming country.

Denver & Rio Grande.—Corey Bros., of Ogden, Utah, who have the contract for building the line from Rifle creek to Grand Junction, Col., 64 miles, have sublet a portion of the work as follows: to David Grant, 7 miles. Sweeney & Nelson, 2 miles, Bean & Sanford, 16 miles, and Bartlett Bros., 4 miles. Work is in progress and the line is to be completed by March 1, 1890.

Union Pacific.—Press dispatches from Boston announce that the contract has been let for the extension of the Utah Southern R. R. to Pioche, Nev., and that the contracts for the remainder of the line will be let soon. The line will terminate at Los Angeles, Cal.

Projects and Surveys.

Port Angeles & Gray's Harbor.—Incorporated to build a line of railway in Washington. Surveys will commence at once.

Los Angeles & San Pedro.—A project is on foot to build a railway from the Los Angeles to San Pedro, Cal. An English syndicate is stated to be behind the scheme.

Western Pacific Ry. & Navigation Co.—Incorporated in Washington by W. H. FIFE, WM. G. CAMPBELL, and GEO. W. FIFE, all of Tacoma.

Idaho, Nevada & California.—The officers of this road are: President, C. W. HINCHCLIFF, Austin, Neb. Vice-President, Governor GEORGE THOUPE, Boise City, Idaho, Secretary, W. J. HILANDS, Cleveland, O., Treasurer, SAML. P. DUNN, East Aurora, N. Y., and chief engineer, C. W. IRISH, Reno, Neb.

RAPID TRANSIT.

Street Railways.—***New York, N. Y.***—It is said that property owners on 5th Ave. are being applied to for consent for a street railway on the avenue from 8th St. to 47th St. The Legislature will be petitioned to grant a charter.

Bethlehem, Pa.—The Bethlehem & South Bethlehem St. Ry. Co. has been incorporated. The road will be 3 miles long, cost $6,000 per mile, and is to be built within a year. President, TRUMAN M. DODSON; Treasurer, GEO. H. MYERS. Capital stock, $50,000.

Orangeburg, S. C.—The Street Railway Co. will apply to the Legislature for an amendment of its charter permitting it to extend the line to the river and to use steam motors.

Atlanta, Ga.—The Union St. Ry. has been sold to H. K. HUNTER, of New York, for $800,000.

Gadsden, Ala.—The Gadsden Land & Improvement Co. will sell its street railway; 2½ miles long, standard gauge, 35-lb. steel rails, 1 Baldwin motor and 2 cars; operates 5 miles of leased road to Attalla. Earnings, over all expenses, lease included, 6 per cent. on $80,000. R. B. KYLE, President.

Blair, Neb.—A franchise has been granted to the Blair St. Ry. Co.

Beatrice, Neb.—The Glenover St. Ry. Co. has been incorporated by E. B. SHERMAN, C. O. BATES, and others. Capital stock, $20,000.

Whatcom, Wash.—A street railway franchise has been granted to the Cornwall Company.

Brockton, Mass.—The East Side St. Ry. Co. will extend its road to the Whitman boundary, to connect with a new road in Whitman.

Cable Railways.—***New York, N. Y.***—The Broadway & 7th Ave. Ry. Co. has accepted the conditions of the consent of the local authorities for the use of cable traction on the Broadway line from South Ferry to Central Park.

Minneapolis, Minn.—The street railway company will build about 13 miles of cable road next spring. Work on the two power stations is in progress; the engines will be built by E. P. Allis & Co., of Milwaukee, Wis. Mr. CLIFT WISE is the Chief Engineer.

Seattle, Wash.—The South Seattle Cable Ry. Co. has been incorporated by J. M. THOMPSON, BAILEY GATZERT, H. G. STRUVE, J. C. HAINES, JACOB FURTH, A. B. STEWART, GEORGE H. HEILBRON, A. P. MILTEN and MAURICE MCMICKEN. Capital stock, $450,000.

San Francisco, Cal.—The Supervisors' Street Committee has been asked by W. H. H. HART, JOHN H. WISE and J. H. SAYRE to grant them a franchise for a cable road.

Electric Railways.—***Jamaica, N. Y.***—The Sprague system is being applied to the street railway.

Greenwich, N. Y.—The franchise for an electric road to Middle Falls, for passenger and freight traffic, has been awarded by the Supervisor and Town Commissioner to Gardner & Rich, of Boston.

Elisabeth, N. J.—A company has been organized to build two lines of electric road.

Philadelphia, Pa.—The new line on Lehigh Ave. is to be operated by storage-battery cars furnished by the National Accumulator Co.

Memphis, Tenn.—The Memphis Electric Ry. Co. has signed the contract with the city. The road will be operated by overhead wires. It will be standard gauge and the form and weight of rail will be decided by the City Engineer.

Ottawa, Ill.—The City Electric Ry. Co. has been organized by L. EMYART, L. B. MERRIFIELD and W. H. STEAD. Capital stock, $125,000.

Merrill, Wis.—Four companies have applied for franchises for electric railways. The Thomson-Houston Co. is represented.

Council Bluffs, Ia.—The Omaha & Council Bluffs Electric Ry. Co., having failed to obtain a right of way across the Union Pacific Bridge, now proposes to build a new bridge.

Toledo, Ia.—The electric light company will build an electric railway to Tama City.

Topeka, Kan.—The Topeka City Ry. Co. has applied for power to operate its cars by electricity.

Sherman, Tex.—The Sherman & Denison Electric Ry. Co. has been organized to build a line 7 miles long. President, N. M. LEE; Secretary, C. W. LEWIS. Capital stock, $300,000.

HIGHWAYS.

Oregon.—The county road from La Conner to Sullivan slough bridge, and the one from there to Pleasant Ridge, have been macadamized by special taxes, and there is now talk of levying a special tax to macadamize the road leading from the bridge across the flats to Bay View, a distance of 6 or 8 miles.

California.—The San Bernardino Supervisors propose opening up Bear Valley and Holcomb Valley. A wagon road to cost about $19,000 will be built.

New York.—The trustees of the village of Mount Vernon have decided to introduce an act in the next Legislature to raise $100,000 for highway purposes.——A new highway is to be laid out, connecting the Mill Creek and Sodom roads about a mile above Johnsburg.

Colorado.—The petition of A. W. RUCKER and others, and WATKIN ELDREDGE and others, of Denver, asking for the opening of the new county roads, have been favorably reported upon by the viewers recently appointed to investigate the proposed work of establishing the roads, and as the report was adopted the new roads will be opened.

CONTRACTING.

Building.—The contract for the court-house at Seattle, Wash., has been let to Smilie & Burrows, of San Francisco, at $163,000, but according to recent reports they have declined the contract. It was decided not to adopt iron columns, the cost being so much greater than brick pillars. The hollow tile furring which the successful bidders are to use without additional cost will protect the interior of the building from moisture and will also make it fireproof. The contract does not include the iron and steel work of the jail, nor the vaults, plumbing and heating plants for the court-house; but it is estimated by Architect RITCHIE, that this work and the grading of the lot, laying sidewalks, and other incidental expenses will not bring the cost of the building above $185,000.

Upon the recommendation of Mr. W. A. RITCHIE, the architect, bids were called for in three forms. First, for the construction of the building according to plans and specifications; second, for hollow tile furring on the inside of all outside walls; and third, for heavy iron columns, instead of brick, at the approaches to the building. The several bids were as follows:

Robert Smilie (Smilie & Burrows), San Francisco—For building according to plans and specifications, $163,000; for iron columns, $11,900; no extra charge for hollow tile furring; contract to be completed in eleven months from date.

Pauly Jail & Lock Company, of St. Louis—According to plans and specifications, $169,750; no bid on iron columns or furring or time specified.

Nelligan & Garrity, Seattle—According to plans and specifications, $173,000; iron columns, $5,000; furring, $2,500; no time specified.

James Parke, Seattle—According to plans and specifications, $181,950; iron columns, $11,000; furring, $2,800; time, twelve months.

Rigby & Evans, Seattle—According to plans and specifications, $183,450; iron columns, $10,000; furring, $1,000; no time specified.

Brannegan & Ryan, Seattle—According to plans and specifications, $184,000; iron columns, $5,000; furring, $2,000; time, eight months.

Fabin S. Potvin, Seattle—According to plans and specifications, $189,000; iron columns, $5,000; furring, $2,500; time, fourteen months.

Jetties.—The residents of Monmouth Beach, N. J. have determined, by subscription, to build a line of jetties in front of their property for a distance of one mile. The contract for the construction of these necessary defences has been given Benjamin Van Brunt, of Mon-

mouth Beach. Work has already been begun and the improvement will be completed by spring.

Cement.—At Baltimore, Md., contracts for furnishing cement for sewers have been awarded as follows: Pulaski St. sewer; Cumberland cement to S. M. Hamilton & Co.; Round Top, John Bullock & Son; Rosendale, Chas. C. McColgan & Co. Eutaw and Fremont St. sewer; Cumberland, Hamilton & Co.; Round Top and Rosendale, Bullock & Son. Wolfe St. sewer; Cumberland, Hamilton & Co.; Round Top, Bullock & Son; Rosendale, McClough & Co. Eager St. sewer; Portland, McColgan & Co.; Cumberland, Hamilton & Co.; Round Top, Bullock & Son; Rosendale, John J. Kelly. Fulton Ave. sewer; Cumberland, Hamilton & Co.; Round Top, Bullock & Son; Rosendale, McColgan & Co. Also contract for furnishing sewer blocks for the Pulaski St. sewer to McClenahan Bros. at $130 per thousand.

Brick.—The directors of the Central Irrigation District, Colusa County, Cal., have let a contract to S. Pence and Jas. McDermott, to supply 1,300,000 brick at $7.50 per 1,000.

Sewer Pump.—At Salt Lake City, Fraser & Chalmers have proposed to furnish a 30 H. P. electric motor to run the sewage pump, for $1,250 f. o. b. New York City, or $1,400 set up; also, to furnish a 25 H. P. electric motor for $1,150 f. o. b. New York, or set up for $1,300.

Sewers.—*Albany, N. Y.*—The following bids have been received for laying a pipe drain in Madison Ave., from Eagle to Lark Sts.:

Bidders.	18-in. pipe per ft.	Each Y branch	Manholes each	Lamp-holes each	Receiving basins each
Jacob Holler	$1.57	$4 35	$85	$15	$115
John Doyle	1.51	3.60	60	15	85
Wm. J. McCann	1.67	3.00	48	20	110
Patrick Murray	2.23	6 07	75	21	100
Wm. E. Murphy	2.65	6.76	65	20	87
P. H. Reilly	1.23	4.75	60	14	76

The contract was awarded to Patrick H. Reilly.

The bids for laying a pipe drain in 2nd St. between Ontario St and New York Central Ave. were as follows:

Bidders	12-in. pipe per ft.	Each Y branch	Man-holes each	Lamp holes each
Patrick Murray	$1.74	$4.28	$74	$20
John Doyle	1.70	4.05	60	15
Wm. E. Murphy	2.75	6.00	65	20
P. H. Reilly	3.00	4.50	70	14

The contract was awarded to John Doyle.

Court Houses.—The commissioners of Whatcom County, Wash., have accepted a block of land donated to the county by the citizens of Whatcom for court house purposes, and entered an order calling for bids, plans and specifications for a brick and stone structure to cost about $75,000. Bids will be opened about January 20, next.——At Red Oak, Ia., the County Board has reached a decision as to plans for the new court-house, accepting a plan offered by H. C. Roch of Milwaukee out of 24 plans in competition. The building is to be fire proof and is to cost $75,000 all complete, including furniture.——Franklin County, Ia., is to have a new $40,000 court-house. The matter was submitted to the voters at the recent election and carried by over 300 majority.

Jail.—The county of La Crosse is to have a new jail, and an issue of bonds to the amount of $50,000 has been authorized for that purpose.

PROPOSALS OPEN.

Street Work.—Grading and granite block pavement. J. P. Adams, Commissioner of City Works, Brooklyn, N. Y. Dec. 3.

Street Work.—Belgian blocks, granite or gneiss for street crossings; 310 sq. yds., 1,530 yds. contemplated blocks 5 to 7 ins. on face, 9 ins. deep. B. H. Hudson, City Engineer, Columbus, Ga. Dec. 3.

Sea Wall.—On North Brother Id. The Health Department, 301 Mott St., New York City. Dec. 3.

Street Work.—Granite block paving on concrete foundation; asphalt pavement on concrete; flagging and curbing. The Commissioner of Public Works, 31 Chambers St., New York City. Dec. 4.

Culvert.—Under the old canal at Holley, Orleans County. James Shanahan, Superintendent of Public Works, Albany, N. Y. Dec. 6.

Pier Work.—Removing all that part of pier, old 39, at the foot of Vestry St., North River, which lies easterly of a line about 80 ft. westerly of the new bulkhead line except the cribwork below low-water mark; for removing all of the shed on said pier, and on the bulkhead platform southerly thereof, and preparing for and building a new wooden pier, with appurtenances, including a sewer-box, on the site of said pier. The Docks Commissioners, Pier A, North River, New York City. Dec. 10.

Street Work.—Grading, curbing, fire brick paving, bouldering, culverts, drains and retaining walls. Thos. J. Smith, President, Board of Public Affairs, Cincinnati, O. Dec. 10, 11.

Tunnel.—Driving tunnel in City Creek Cañon. Plans and specifications on file. Heber M. Wells, City Recorder, Salt Lake City, Utah. Dec. 10.

Supplies.—For Brooklyn navy yard. Blocks, screw bolts, brushes, shovels, brick, canvas, globe valves, cordage, wire rope, locks, lamps, lanterns, leather belting, pine lumber, twist drills, sheet lead, brass, zinc and tin, tool steel, iron, nails, tacks, nuts, oil, packing, alcohol, paints, screws, books, etc. James Fulton, Paymaster General, U. S. N., Navy Department, Washington, D. C. Dec. 12.

Iron Work.—Iron floor of U.S. building at Port Townsend, Wash. James H. Windrim, Supervising Architect Treasury Department, Washington, D. C. Dec. 13.

Court House.—Plans and specifications on file Frank Rice, Chairman of Building Committee, Kearney, Neb. Dec. 14.

Steel Plates.—For U. S. S. *Texas*. About 661 tons (2,240 lbs) of steel plates 40 lbs. per sq. ft., for use in the construction of this battle ship; about 246 tons of such plates being for the lower layer of protective deck plating, and about 415 tons for the upper and middle layers of protective deck plating, the upper and lower layers of top of redoubt and the protective side plating. Hon. B. F. Tracy, Secretary of the Navy, Navy Department, Washington, D. C. Dec. 16.

Electric Lighting.—For a term of 10 years. Edwin Henderson, City Clerk, Cincinnati, O. Dec. 16.

Court House.—Plans, specifications and bids for a brick building. J. T. Van Hoy, County Clerk, Childress, Tex. Dec. 18.

Court House.—Stone building. J. G. Abney, County Judge, Hillsboro, Tex. Dec. 19.

Bridge.—Automatic self-closing swing bridge over canal at Benson St.; iron pile substructure. F. Raine County Auditor, Cincinnati, O. Dec. 20.

Street Work.—Paving and improvement of streets. Geo. R. Bringhurst, City Secretary, Houston, Tex. Dec. 23.

MANUFACTURING AND TECHNICAL.

Brakes.—The Hanscom Air Brake Co. has been organized in San Francisco. The capital stock amounts to $10,000,000, of which $3,500,000 has been actually subscribed. Directors: Louis Sloss, G. Niebaum, P. M. Lilienthal, and W. T. Garrett, of San Francisco; W. Kohl, of San Mateo; H. D. Bacon and F. B. Bacon, of Oakland.

Asphalt.—The Grayson County Asphalt Mining & Contract Co. has been incorporated at Louisville, Ky., by O. C. Richardson, J. M. Hardin, J. S. Cain, and others to develop asphalt lands. Capital stock, $500,000.

Sewer Pipe.—The Sidney Sewer Pipe & Terra Cotta Co. has been organized at Seattle, Wash., by Frank L. Hilton, Saban H. Wheeler, and John Melcher. Capital stock, $50,000.

The Southern Railway & Equipment Co. has been organized at Atlanta, Ga., by W. F. Spalding and Alex. W. Smith. Capital stock, $50,000.

The Southwestern Construction Co. has been organized at Hutchinson, Kan., to build railways and telegraph lines. Capital stock, $50,000. Directors: Geo. W. Booth, G. A. Walkup, R. E. Wise and H. A. Christy, of Chicago; S. A. Darrough, of Anthony; Wm. E. Hutchinson and A. J. Lusk, of Hutchinson.

Iron Works Plant.—J. P. Witherow & Co., of Pittsburg, are arranging contracts for the erection of extensive plants, blast furnaces and rolling mills at Cumberland Gap, Tenn., and furnaces at Sheffield and Birmingham, Ala.

Asphalt Block Pavement.—The California Compressed Asphalt Brick Pavement Co. will establish a factory at Oakland, Cal., with a daily capacity of 7,000 bricks per day. It will cost $35,000. The blocks are made of bitumen and lime rock compressed, and in size are 12 x 4 x 5 ins. The lime rock will be obtained in California and the bitumen imported by ship from the Island of Trinidad. One cargo has already been contracted for. The cost of the block pavement is about the same as that of the sheet asphaltum. It varies with the nature of the base required, from 25 cts. to 30 cts. per sq. ft. A sample piece of pavement has been in use in San Francisco for 18 months. President, Columbus Waterhouse; Secretary, Jacob Hornes; General Manager, C. B. Taylor. Capital stock, $250 000.

The Porter Mfg. Co., of Syracuse, N. Y., is doing considerable western work and is very busy with boiler business and stand-pipes.

Electric Headlights.—The Atwood Electric Co. has been incorporated at East St. Louis, Ill., by L. C. Atwood, E. B. Roth and C. C. Weaver to manufacture electric headlights for locomotives. Capital stock, $500,000.

The San Francisco Mfg. & Improvement Co. has been incorporated by J. J. Scrivner, A. A. Hoyt, E. P. Fish, and others, of San Francisco, and A. J. Meany, of Merced, to engage in street and sewer work. Capital stock, $100,000.

Pneumatic Gun Carriage.—Secretary of War Proctor has awarded a contract to the Pneumatic Gun Carriage & Power Co., of Washington, for a pneumatic gun carriage, to be delivered at the ordnance proving ground, Sandy Hook, N. J., before Oct. 31, 1890, for experimental purposes. The contract price is $48,000.

The Federal Steel Co. has been organized at Cleveland, O., by a consolidation of the wire, wire nail, and barb wire companies. Capital stock, $12,000,000. Of this $6,000,000 will represent the value of the real estate, buildings, machinery and good will of the absorbed companies. From $4,000,000 to $6,000,000 will represent the cash paid in by investors. A contract has been made with the banking firm of Drexel, Morgan & Co. for the cash capital.

The Tacoma Contract Co., of Tacoma, Wash., has been incorporated by E. B. Cushing, F. A. Smalley and Geo. M. Stewart. Capital stock, $100,000.

Carts.—The Hitchcock Mfg. Co., of Cortland, N. Y., has made arrangements for building a large number of carts.

Aluminum.—The Chicago Aluminum Producing Co. has been incorporated by W. C. Bruson, H. Booth and H. P. Hurd. Capital stock, $600,000.

The Walworth Mfg. Co., of Boston, Mass., has issued an illustrated price list of stop cocks, pipe cutters, etc. This firm manufactures the Hall tapping machine and the Morgan extension boxes.

The Industrial Works, of Bay City, Mich., have recently received two orders for 35-ton wrecking and construction cranes, similar to their latest design and as embodied in a crane recently built for the Kansas City, Ft. Scott & Memphis road. These cranes are for the Michigan Central and Rio Grande Western. They have also an order for two steel 15-ton transfer cranes for the Pennsylvania Railroad, and will build a powerful traveling crane for the Jackson shops of the Michigan Central. The capacity of these works is being increased at the present time by the addition of new machinery in several departments. This has been rendered necessary by the rapidly growing demand for the specialties manufactured.

The Taunton Locomotive Mfg. Co., of Taunton, R. I., has facilities for producing good iron castings and has its works well equipped to build marine and stationary boilers, tanks and plate iron work generally, having added to its plant a new steam riveting plant made by Wm. Sellers & Co.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have delivered 5 mogul freight engines to the New York Central.

The Manchester Locomotive Works, of Manchester, N.H., have shipped another engine to the Boston & Maine.

The Rogers Locomotive Works, of Paterson, N. J., have sent 9 freight engines to the Georgia Pacific.

The New York Locomotive Works, of Rome, N. Y., have completed 5 mogul engines for the New York Central.

H. K. Porter & Co., of Pittsburg, Pa., have built a narrow-gauge switching engine for the Washington navy yard.

Cars.—The Lafayette Car Works, of Lafayette, Ind., have completed 200 box cars for the Lake Erie & Western and are now building 500 cars for the Lake Shore & Michigan Southern.

The Terre Haute Car Works, of Terre Haute, Ind., have an additional contract for 100 stock cars for the Cleveland, Cincinnati, Chicago & St. Louis. They will be 36 ft. long, equipped with air brakes and automatic couplers.

The Peninsular Car Co., of Detroit, Mich., has a contract for box cars, stock cars, furniture cars, and fruit cars for the Union Pacific.

The Michigan Car Co., of Detroit, Mich., has a contract for 30 flat cars and 160 coal cars for the Union Pacific.

The Ohio Falls Car Co., of Jeffersonville, Ind., has a contract for 400 box cars, 400 flat cars, and 200 coal cars for the Georgia Central.

The Richmond Locomotive & Machine Co., of Richmond, Va., has built some street cars for the Main St. line.

The Pond Engineering Co., of St. Louis, is furnishing the Holden, Mo., Water Co., with a 50-H. P. Armington & Sims engine for running an electric light plant, and the Thomson-Houston Co., of Omaha, with a 14-in. grease extractor with oil cylinder complete. Two of the largest size Pond Engineering Co.'s feed pumps and receivers have been shipped to Normal, Ill.

Steam Heating.—S. P. Shadle, Elizabethville, Pa., wishes to correspond with manufacturers regarding boilers and fittings for heating by steam a building 36 x 72 ft.

A. & W. S. Carr Co., of 138-140 Center St., New York, manufacturers and dealers in plumbers' and machinists' supplies, have lately enlarged their factory at Paterson, N. J., by an addition 110 ft. by 40 ft.

The Westinghouse Machine Co. reports sales during the month of October of 110 engines aggregating 6,035 H. P. This is the largest in the company's history for any one month. This remarkable output is made possible by a very complete plant run day and night.

Machinery Wanted.—Michael Muldoon, of Louisville, Ky., wants to purchase hoisting machinery.

Small second-hand railway iron, Albert Montgomery, Stock Landing, New Orleans, La.

Second hand 6 Rider and 8 Ericsson pump, Charles Henizer, 547 West 110th St., New York City

Two dial feed power presses for light work or light side wheel presses without feed attachment. Newark Rivet Works, Newark, N. J.

A second-hand Sturtevant or Root blower, 6 or 8-in. outlet. P. O. Box 555, Cincinnati, O.

Sturtevant blower, 36 to 40 in. second hand. Commercial Button Co,, 1228 Second Ave., New York City.

A light set of power plate bending rolls and a pair of strong alligator shears in good order. Manufacturer, box 253 Herald Uptown office, New York City.

A second-hand 75 H. P. automatic cut-off engine; address with full particulars, or no notice taken. Bolton & Spadone, 28 Morton St., Brooklyn, N. Y.

BRIDGES AND CANALS.

Bridge Notes.—*Newbury Center, Vt.*—The selectmen have decided to build an iron bridge across the Wells River at Bottomville.

Easton, N. Y.—A toll bridge is to be built at Schuylerville.

Newark, N. J.—The Finance Committee of the Board of Freeholders have decided to issue thirty-three $1,000-bonds, running for one year and bearing 5 per cent. interest, these bonds being issued to pay for the rebuilding and repair of bridges damaged by the recent freshets.

New Brunswick, N. J.—If the Pennsylvania R. R decides to raise its tracks through the town, a new bridge will be built over the Raritan River.

Lancaster, Pa.—The County Commissioners have reported that the iron bridge over the Conowingo, which was shifted by the recent flood, is so badly wrecked as to be completely beyond repair, necessitating the erection of a new structure.

Reading, Pa.—Temporary structures have been built to replace bridges and trestles washed away, until arrangements can be made for building new permanent structures.

Harrisburg, Pa.—The Peoples' Bridge Co. is building a highway bridge over the Susquehanna.

Cumberland, Md.—The County Commissioners have received bids for the erection of an iron high Pratt truss bridge of two spans each, 84 ft. between the abutments with a 12-ft. roadway with a capacity of 80 lbs. per sq. ft.

Washington, D. C.—It is proposed to remove the old Long Bridge and build a new structure. An appropriation for this purpose has been applied for.

Charleston, W. Va.—The Charleston & South Side Bridge Co. has been organized to build a bridge across the Kanawha River. President, B. L. WOOD, Jr., of Pittsburg, Pa.; Vice-President, S. M. SNYDER, of Charleston; Secretary, W. O. DAUM, of Charleston. Capital stock, $50,000.

Wheeling, W. Va.—The Wheeling Bridge Co., which is backed largely by Pittsburg capital, intends building two big bridges, one from Wheeling to Wheeling Island, and the other from the island to Etnaville, on the other side of the river. The structure will be of steel, and will cost over $500,000. It will accommodate the tracks of the electric street railway, and will have passage ways on each side for pedestrians. G. W. G. FERRIS, of Wheeling, is the engineer who designed the bridges. The contract calls for their completion by Aug. 1 of next year.

Mumfordville, Ky.—It is proposed to build an iron bridge across the Green River. For particulars address the mayor.

Jeffersonville, Ind.—The first stone for the first pier of the new bridge between Jeffersonville and Louisville has been laid. The bridge will be of iron, will be 3,650 ft in length, and will have three channel spans of 550 ft' each.

Portland, Mich.—It has been decided by public vote to issue bonds for $6,500 for an iron bridge across Grand River.

St. Cloud, Minn.—The St. Cloud Bridge Co. has signed the contract with the City Council to build the 10th St. bridge. The contract price is $81,876, and the plans and specifications call for a single intersection iron bridge with stone abutments consisting of four spans of 201½ ft. The roadway is to be 19 ft. above the water. Work will be begun about the middle of December, and the contract completed by June 1, 1890.

Sioux City, Ia.—The Pacific Short Line, the railway now building between Sioux City and Ogden, has closed a contract with J. M. MOEN, President of the Sioux City Pontoon Bridge Co., for the building of a bridge across the river at Sioux City. The bridge will be 2,280 ft. long, and of the combination type, carrying steam and cable car tracks, besides an extra floor for pedestrians and wagons.

Kansas City, Kan.—City Counsellor KEPLINGER recently rendered an opinion in which he held that the mayor and council had no authority to award contracts for bridges costing over $2,000 unless authorized by a majority of the people at an election. The council then rescinded the contract for the construction of the 4th St. Bridge across Jersey Creek. This decision will doubtless cause a long delay in the construction of the proposed bridge. The engineer was directed to prepare plans for a wooden bridge to cost less than $2,000.

Del Norte, Col.—The contract for a bridge over the Rio Grande has been awarded by Mr. J. P. MAXWELL, State Engineer, to the Bullen Bridge Co., for $3,68'. It will be a combination bridge with 2 spans, 100 and 117 ft.

Portland, Ore.—Plans and specifications for the bridge across the Tanner Creek Gulch on 13th St. have been prepared in the office of W. T. CHAPMAN, Superintendent of Streets. The bridge will have a pile foundation. It will be 350 ft. long, with a 50 ft. roadway and 8 ft. sidewalks. The highest bents will be 45 ft. high.

Red Bluff, Cal.—The Tehama Supervisors have awarded a contract for a bridge over Reed's Creek to the Pacific Bridge Co. at $6,480.

Hempstead, Tex.—The contracts for 3 wooden bridges on public roads have been awarded to D. A. Woods, at $2 per ft.

Canals.—*California.*—Work on the Orland Canal was commenced Nov. 9.

Pennsylvania.—That portion of the Pennsylvania Canal between Bald Eagle Dam, Clinton County, and Loyal Stock Creek, Lycoming County, a distance of 55 miles, has been abandoned for public use.

Bridge Works.—Works for the manufacture of iron and steel bridges will be established at Frederick, Md., by H. G. Welty.

Viaducts.—*Jacksonville, Fla.*—The committee on the budget has recommended that the budget be amended by adding to the amounts required by the Board of Public Works a sum not to exceed $9,000 to be used in paying the city's portion of the cost of the viaduct over the railroads on Bridge and Commercial Sts., and the opening of Clay St.

Yankton, Dak.—The following proposals for the construction of an iron bridge of 280 ft. span over the Jim River have been received by Mr. E. D. PALMER, City Engineer and County Surveyor. All the bids were rejected, and new ones, for a two-span structure, will probably be advertised for.

Penn Bridge Co., Beaver Falls, Pa.	$13,842
Lane Bridge & Iron Works, Chicago, Ill	13,857
Wrought Iron Bridge Co., Canton, O.	14,302
Smith Bridge Co., Toledo, O.	14,300
King Bridge Co., Des Moines, Ia.	14,499
Massillon Bridge Co. (A. Y. Bayne & Co., Minneapolis)	14,572
St. Louis Bridge & Iron Co.	14,787
Milwaukee Bridge & Iron Works	14,787
Youngstown Bridge Co., Youngstown, O.	15,635
Clinton Bridge & Iron Co., Clinton, Ia.	15,780
Missouri Valley Bridge Co., Leavenworth, Kan.	16,300
Phœnix Bridge Co., Phœnixville, Pa.	18,325

ELECTRICAL.

Electric Lighting.—*Montpelier, Vt.*—The Standard Light & Power Co. has put in a 125 H. P. Buckeye engine, 3 water wheels, 4 arc dynamos and 3 incandescent dynamos. The engines and water wheels together will furnish 700 H. P., and at the present time they are running 140 arc and 1,600 incandescent lights. The new dynamo is to run incandescent lights in Barre. W. J. BAGLEY is Electrician, and C. A. BAILEY, Superintendent.

North Adams, Mass.—The North Adams Electric Light & Power Co., which is controlled by the gas company, has made a contract to light the fire district by electricity, and 12 lights are to be put in at once. The same power will be used which now runs the incandescent system, but in the spring the company will erect a complete plant near the gas-works and will furnish its own power.

Bath, N. Y.—The Board of Trustees has received a proposition from the East Albany Gaslight Co. offering to equip and maintain 40 lights every night during the year at $18 per light for 16 c. p. lights, and $20 for 25 c. p. lights.

Cranford, N. J.—A contract has been signed to supply Cranford and the adjacent town of Westfield with electric lights. A site has been purchased by the Thomson-Houston Company, and work on the plant will be begun immediately.

Ocean Grove, N. J.—The Ocean Grove Camp Meeting Association has arranged to greatly enlarge their electric lighting plant between now and next spring, and have contracted with the Heisler Electric Light Co., of St. Louis, for two of their largest dynamos. The previous orders of the Association covered four Heisler dynamos.

Sewickley, Pa.—The Sewickley Electric Co. has been incorporated by WALTER D. UPTEGRAFF, J. M. UPTEGRAFF, C. C. WOLFE, EDWIN E. LITTLE, ALLEN MATHENS, all of Pittsburg. Capital stock, $5,000. They will also light the borough of Osborne and Lieb township.

Norfolk, Va.—An electric light company has been organized, President, H. L. MAYNARD.

Alexandria, Va.—Both boards of the City Council have agreed to accept the plant established by the Schuyler Co. The city agreed to take 19 arc lights instead of an option of 117 incandescent, using 3 incandescents only at the electric works. This will give the city 84 arc lights; 65 only of these are now in use, the others being reserved for renting or further public needs.

Harrodsburg, Ky.—The Harrodsburg Electric Light & Power Co. has let the contract for its plant to the Jenney Electric Light Co., of Fort Wayne, Ind.

New Iberia, La.—The New Iberia Electric Light & Power Co. has been organized. President, J. A. BREAUX; Secretary, W. M. GATES. Capital stock, $10,000.

New Orleans, La.—The Louisiana Electric Light & Power Co. has been organized as the Louisiana Electric Light Co. The Jenney Co., of Fort Wayne, Ind., has taken a large amount of the bonds. The plant will be considerably increased.

Genesee, Ind.—The town is to be lighted by electricity.

Bloomington, Ill.—The Citizens' Gaslight & Heating Co. has awarded a $30,000 contract to the Westinghouse Electric Light Co., of Pittsburg, to put in an electric plant, arc and incandescent, to be operated in connection with the gas plant.

Rochester, Minn.—At the meeting of the Common Council it was decided to give the Northwestern Electric Construction & Supply Co. the franchise and a contract which allows $115 apiece per year for five arc lights to be placed on our streets.

Litchfield, Minn.—A vote was taken Nov. 25 on the proposition to issue bonds for an electric light plant.

St. Charles, Mo.—The Committee on Electric Lighting will receive bids for supplying the city with a complete electric light plant up to Dec. 1. The committee will also solicit propositions to light the city by contract up to the same date.

Butler, Mo.—An electric light franchise has been granted to a company.

Eureka Springs, Ark.—The Interstate Gas Co., of St. Louis, Mo., which owns the Eureka Gas Works, has been granted an electric light franchise.

Nottingham, Ala.—The Nottingham Water & Light Co. will put in an electric plant. President, CALVIN DETRICK, 47 Broadway, New York City.

Underground Wires.—The Northwestern Telephone Exchange of St. Paul, Minn., has been granted a franchise to lay its wires in underground conduits.——At Cincinnati, O., the Committee on Lighting has recommended that the Board of Public Affairs order all electric light and power wires to be placed under ground, except such as are used by electric railroads for motor purposes; also that the Council be requested to provide by ordinance for a system of underground conduits. These conduits should be so constructed that but one line should be required in any one street or alley, and they should be such capacity that the various companies desiring to supply light or power could be accommodated on equal and reasonable terms.

The Heisler Electric Light Co., of St. Louis, Mo., has been awarded first premiums for the best system of incandescent lighting and the best incandescent dynamo and regulator at the Texas State Fair and Dallas Exposition.

SEWERAGE AND MUNICIPAL.

Sewerage.—*Hillsborough, N. H.*—It has been decided not to build the sewers yet. The surveys have been made.

Lynn, Mass.—The city has ordered that the outfall sewer be built under the direction of the Committee on Drainage.

Cumberland, R. I.—The construction of a syste of sewers is projected, and is being considered by the council.

Bloomfield, N. J.—The proposition of Engineer C. P. BASSETT to the Orange Common Council in regard to sewerage has aroused an interest in that matter in both Bloomfield and Montclair, and it is not unlikely that the Township Committees of both townships will take some action towards entering into a combination with Orange in ascertaining the cost of a comprehensive system.

Baltimore, Md.—The sewer appropriations authorized by ordinance this year aggregate $1,344,710.

Washington, D. C.—The appropriation for the year 1889 was $70,000, and the construction for the year aggregated 39,185.2 lin. ft. of sewer, varying in size from 6in. to 36 x 52 ins. egg-shaped section. The appropriation for the current year is $90,000. This, the report says, should be increased for the coming year and estimates are presented aggregating $127,860.

Brunswick, Ga.—The city will take a vote on Dec. 14, on the question of issuing $300,000 of bonds to construct a sewerage system and other public works.

Rome, Ga.—Mr. R. F. HARTFORD, engineer of the Hydraulic, Sanitary & Electrical Works, of Chattanooga, Tenn., has made an investigation and will prepare plans and a report upon sewerage system.

Merrill, Wis.—The Center Ave. Sewer Co. has been incorporated by W. A. SCOTT, H. C. ROSE, J. W. LADD, and others. Capital stock, $1,800.

Winona, Minn.—The sewerage question has again been under discussion and it is probable that another committee will be appointed to investigate the matter.

Los Angeles, Cal.—Open storm drains have been suggested by R. M. WIDNEY. The Sewer Committee of Councils has reported in favor of appointing five engineers to carefully consider the recommendations of the joint Sewer Committee and all plans that have been submitted to dispose of the city sewage. The engineers selected are RUDOLPH HERING, of New York; GEORGE

C. KNOX and GEORGE HANSON, of Los Angeles; AUGUSTE MAYER, City Engineer of Pasadena; and FRED. EATON, City Engineer of Los Angeles.

Street Work.—*Baltimore, Md.*—The West Baltimore Improvement Association has submitted to the Council several ordinances for street extension, grading, curbing and paving. The city will open several new streets.

Roanoke, Va.—A force of men, under the direction of Mr. J. A. MCCONNELL, are widening Melrose Boulevard, and the company has let the contract to Mr. MCCONNELL for macadamizing the boulevard and widening the extension of this thoroughfare.

Mobile, Ala.—The city has awarded a contract for cleaning and repairing the streets for 5 years and the laying of 4,000 yds. of cypress block paving each year at $21,000 per year.

Denver, Col.—Upon recommendation of City Engineer MCINTYRE, the Board of Public Works has decided to specify concrete instead of sand foundation for stone paving. The city engineer states that the foundation of concrete will cost 50 cts. a yard more, but thinks the estimate he gave will cover this. This will make stone pavement dearer, and will not affect the asphalt, as in the latter kind the concrete foundation is always used. ——The property owners on 16th St. have decided in favor of asphalt pavement and have appointed M. J. LAWRENCE, W. G. FISHER and JEROME S. RICHE a committee to examine into the merits of the various kinds of asphalt.

Toronto, Ont.—The city will open a new street on the line of the Rosedale Creek sewer at a cost of $12,000. E. & C. FARQUHAR, of Toronto, have the contract for block paving on Lake View Ave.

Municipal Improvements.—*Key West, Fla.*—Bonds for $500,000 are to be issued for sewerage, grading and paving. W. D. CASH is Chairman of the Finance Committee.

Argentine, Kan.—It is proposed to issue general improvement bonds for $75,000, for sewerage, viaduct, city hall, etc.

Drainage.—*Illinois.*—At Tuscola, Judge HUGHES granted an injunction against the Arcola drainage-canal commissioners, restraining them from taking any steps, the farmers of that section asking that they be tied up. Four sets of drainage commissioners are now enjoined, and the drainage fight is at its warmest. There are 50,000 acres in the four districts, and 95 per cent. of the landowners are against the drainage canal.

Jacksonville, Fla.—City Engineer FARQUHAR is having a ditch dug for the drainage of the western part of the city. The ditch crosses a swamp.

WATER-WORKS.

NEW ENGLAND.

Orono, Me.—Reliable parties inform us that the recent vote on the question of constructing works, defeated the project, instead of favoring it as stated in our issue of Nov. 16. [It is our aim to have our notes accurate and true. When they are otherwise, it is because mistatements have been made in press reports before reaching us. We shall always be obliged to our readers for similar reports of inaccuracies.—ED.]

Derry, N. H.—The Derry Water-Works Co. has been organized. The officers are: President, W. S. PILLSBURY; Treasurer, F. J. SHEPARD; Clerk, FRED. R. FELCH.

Wolfborough, N. H.—Rapid progress is being made on the aqueduct, and mains are being laid through the principal streets. The supply is taken from a large pond on elevated land about 4 miles west of the village.

Windsor Locks, Conn.—The new works have been satisfactorily tested.

MIDDLE.

Hamburg, N. Y.—The new mains have been tested, and the stand-pipe completed.

Baldwinsville, N. Y.—The supply for the new works, constructed on the stared pipe system, is furnished by a well 20 ft. in diameter by 20 ft. deep. It is lined with boiler iron, and flows 180,000 galls. per hour. The works are nearly completed. Mr. SMALLEY is the Engineer.

Bay Shore, N. Y.—Several experimental supply wells have been sunk, and pipe laying for the distribution system is being pushed forward rapidly.

Cranford, N. J.—The town officials are considering a plan for obtaining a water supply. Address the Town Clerk.

Bordentown, N. J.—The recent analysis of the water by which it was found to be impure has caused considerable disturbance. The Board of Health has taken action in the matter by recommending that the company establish a system of filtration.

Asbury Park, N. J.—The Monmouth County Water Co. has been incorporated at Long Branch, with a capital stock of $500,000 divided into 100 shares. Its purpose is to supply all the towns in the vicinity of Long Branch, and Asbury Park with water at low rates. The incorporators are: President, Gov. ROBERT S. GREEN, of New Jersey, G. HILTON SCRIBNER, of New York, SHEPARD HOMANS, WM. BLAIKIE, and R. H. ROCHESTER, of Englewood, N. J.

Philadelphia, Pa.—The Newtown *Enterprise* has suggested artesian wells as a source from which to obtain a pure water sup

SOUTHERN.

Albany, Ga.—The question of establishing works is being actively discussed.

Rome, Ga.—It is reported that private parties are negotiating for the purchase of the city's works.

Albany, Ga.—A citizen's vote will soon be taken of the question of constructing an extensive system of works. Address Mayor MCINTOSH.

Nottingham, Ala.—The Nottingham Electric Light & Water Co. is to construct a system of works. Address CALVIN DETRICK, President, 47 Broadway, New York City.

North Knoxville, Tenn.—E. WOLTMANN, of New York, has made a proposition to build works, if the town will take a specified number of hydrants at $35 per year. An ordinance submitted with the proposition was passed by the City Council upon first reading.

Lexington, Ky.—Superintendent S. A. CHARLES has gone to Boston to confer with the directors of the water company in regard to enlarging the reservoirs or adding a new one. Surveys have been made, and plans and specifications completed. One of the plans calls for a new dam 1,700 ft. below the present one, to be 30 ft. high, forming a lake of 33½ acres, and have a capacity 120,000,000 galls. Estimated cost, $43,000. The second plan calls for a dam 35 ft. high, 3,000 ft. below the present one, forming a lake of 73 acres, with a capacity of 260,000,000 galls. Estimated cost, $66,000.

Covington, Ky.—The first of the three reservoirs to be constructed in connection with the new works has been completed and put into use.

NORTH CENTRAL.

Cleveland, O.—Plans and drawings for a tunnel under the river have been completed by JOHN WHITELAW, Superintendent. It is to be about 400 ft. long, and 7½ ft. in diameter. The estimated cost is $25,000. Specifications will soon be completed and proposals invited for executing this work.

East Liverpool, O.—A movement is on foot to lay a 15-in. to replace the 4-in. main, in the vicinity of the china works, and build a new reservoir on the land recently donated, on the hill in Houston's addition.

Toronto, O.—Bids will be received until Dec. 4, for constructing a system of works, by W. B. GOUCHER, President Water-Works Trustees.

Huntington, Ind.—Bids will be received until Jan. 13, 1890, by JOSEPH M. BLACK, City Clerk, for constructing a complete system of works.

Edwardsville, Ill.—It is reported that the city would probably grant a franchise to a reliable company. Address W. H. HALL, City Clerk.

Chicago, Ill.—About 1,100 ft. of the new four mile water tunnel, under Lake Michigan, has been constructed. Work was begun in Jan. 1887, and it is expected to be completed in Nov. 1891.

SOUTHWESTERN.

Helena, Ark.—The Helena Gas, Power & Water Co. has been organized with a capital of $10,000. The officers are: NICK STRAUB, President: B. B. WADDELL, Vice President: WM. NEAL, Secretary, L. LUCY, Treasurer.

Bryan, Tex.—The construction of the new works has been commenced.

Lake City, Col.—It is reported that a system of works is to be constructed at once.

NORTHWESTERN.

Minden, Neb.—The town has voted to issue $25,000 of bonds for constructing works.

Minneapolis, Minn.—It is reported that the proposition to adopt the use of meters throughout the city will probably be carried. About 500 are already in use.

Coolidge, Kan. — E. N. PECK, President of the water company, sends us the following information:

The capital stock of the Peck Water-Works was increased to $60,000 on Nov. 6. Additional mains will be laid, new machinery added, and the works improved generally.

Madison, Neb.—Bids have been received for the $10,000 of city water bonds, but no award has yet been made.

Omaha, Neb.—It is reported that the city is desirous securing better water. Also that parties wishing to make propositions will be furnished full information by addressing the city engineer. The proposed plan is to tap the Platte River.

New Fort Omaha, Neb.—A permanent U. S. A. Post is to be established, the Government having appropriated $133,000 for starting the erection of buildings. It is reported that the water supply will be furnished by the American Water-Works Co., by extending their main from South Omaha. Estimated cost, $3,000.

PACIFIC.

La Conner, Wash.—Arrangements have been made for a new engine and pump.

Whatcom, Wash.—Pipe for the new works has been received. The supply is to be taken from Lake Whatcom.

Seattle, Wash.—The report for a permanent system of water supply, submitted to the City Council by Consulting Engineer BENEZETTE WILLIAMS, of Chicago, has been adopted. By it he recommends that Rock Creek be the principal source of supply, but that instead of piping the water direct to the city, that it be conducted into Swan Lake, with such other water as may come in the way, and that this lake be used as a head or impounding reservoir. From Swan Lake it is proposed to feed a high service and a low service gravity system, each supplied through one conduit, also to establish a high service pumping system to be supplied from the upper reservoir, for such portion of the city as can not be reached by the high service gravity works. The total estimated cost of the new works, including that portion of the Spring Hill Co.'s plant which could be utilized is about $950,000.

Chehalis, Wash.—Bids are wanted by the Chehalis Flume & Aqueduct Co. for making excavations for a flume.

McMinnville, Ore.—The new works will be put in operation about Dec. 1.

Redlands, Cal.—The San Timoteo Water Co. has been incorporated with a capital stock of $100,000, divided into 2,000 shares. The directors are: D. A. COVINGTON, W. E. SIBLEY, S. V. HORTON, P. H. COVINGTON, and L. A. CANTERBURY.

San Bernardino, Cal.—The citizens recently voted to issue the $160,000 of bonds for new works.

Los Angeles, Cal.—The Duarte Water Co. has been incorporated. The directors are: H. S. DANIELS, H. D. FOWLER, J. M. PIRTLE, W. CHAPPINDIT, and ERNEST WILSON.

Napa, Cal.—The California Water, Gaslight & Fuel Co. has been incorporated with a capital stock of $250,000. The directors are: HENRY PEASE, L. D. STARKWEATHER, JAMES H. RUSS, J. W. BROWN, and D. C. SCOTT.

CANADA.

Halifax, N. S.—The question of increasing the capacity of the city's works is being discussed, and plans to this end have been presented to the City Council by City Engineer E. H. KEATING. He recommends that steps be taken to keep the consumption within reasonable bounds by stopping the present waste of water; also to enlarge the capacity of the reservoirs.

Niagara Falls, Ont.—A new system of works is being established. A tunnel is being constructed, 6 by 7 ft. by 125 ft. long, the mouth of which is 35 ft. below the brink of the Horseshoe Falls. It has reached a depth through solid limestone rock of about 50 ft. When completed it is to serve as a tail race from the wheelhouse to the pump-house. Water to operate the works will come to the wheelhouse through a wooden conduit 6 by 8 ft. long. The works are expected to be in operation by June, 1, 1890.

Lucknow, Ont.—The city has sold $10,000 of bonds to Geo. A. Stinson, of Toronto, at $11,456.25.

FOREIGN.

Havana, Cuba. — The Government has awarded the contract for building a new water-works system to Runkle, Smith & Co. The contract price is $2,000,000.

ARTESIAN WELLS.

Pasadena, Cal.—The Hurlbert artesian well is down 1,250 ft.

Parker, So. Dak.—F. L. CLISBY, City Clerk, informs us that no bids for sinking the well have been received.

Sturgis, Dak.—The town has voted $2,000 for sinking a well.

Denmark, Ia.—A well is to be sunk. Address the Town Clerk.

Boone, Ia.—Bids are wanted for continuing the work on the city's well.

Prairie Plains, La.—It is reported that A. F. REA contemplates sinking a well.

Castle Rock, Col.—A company has been organized with a paid-up capital of $25,000 to prospect the Soloman land, near Greenland, for artesian water, etc.

Santa Fé, N. M.—Le Fever & Riddles, of Florence, Col., are sinking a 1,000 ft. test well. If successful, a large number of wells will probably be put down in this vicinity.

IRRIGATION.

California.—The following reservoirs are reported as now being in process of construction in Lassen County: Two in Horse Lake Valley, Contractor A. Gallatin; Alexander Bros., one in Horse Lake Valley; Cox & Co., one in Willow Creen; J. W. Shanklin, three on Grasshopper Creek; John C. Davis, one at Skedaddle; E. R. Dodge, one at Ball's Cañon; Hutchinson & Leavett, three; one at Alkali Lake, east of Susanville, one at McCoy's Flat, and one on Hog Flat, on Susan River; F. C. Dunne & Co., one at Red Rock. The Directors of the Central Irrigation District, of Colusa County, have let a contract for 1,200,000 bricks at $7.50 per 1,000.

Denver, Col.—The Midland Canal, Reservoir & Land Co. of Prowers and Bent counties, has been incorporated.

New York, N. Y.—An application has been received by the Commissioner of Public Works from the New York Hydraulic Supply Co., asking permission to lay 10-in. mains in several down town streets, including Broadway and West St., to furnish water to factories, docks and warehouses. In return they offer to supply the fire department with water free, and to deposit in the City Treasury 5 per cent. of their gross receipts.